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ABSTRACT

This manual provides information needed to meet the standards for pesticide applicator certification. The emphasis of this document is on the identification of wood-destroying pests and the damage caused by them to the structural components of buildings. The pests discussed include termites, carpenter ants, beetles, bees, and wasps and numerous rodents, especially mice and rats. (CS)

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COOPERATIVE EXTENSION SERVICE

University of New Hampshire

INDUSTRIAL - INSTITUTIONAL - STRUCTURAL

AND HEALTH RELATED PEST CONTROL

CATEGORY MANUAL

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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James S. Bowman

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SE 024 017

COMMERCIAL PESTICIDE APPLICATOR TRAINING

This training manual is intended to provide you with the information you will need to meet the standards of the E.P.A. for pesticide applicator certification, and prepare you to take an examination given by the State of New Hampshire Department of Agriculture based on this manual. It is not intended to provide you with all the information you need for effective pest control. Additional information in the form of publications and short courses can be obtained from the Cooperative Extension Service.

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WOOD-DESTROYING PESTS

BENEFICIAL INSECTS CONVERT WOOD TO SOIL

Wood-destroying insects fit into nature's scheme for changing fallen trees and other vegetable matter back into soil. Were it not for the termites, other insects, and fungi, decomposition of dead trees in the forest would take far longer than it now does and the forests would be impenetrable with masses of undecomposed tree trunks.

Many insects and fungi attack trees and use them in various ways for food, shelter, or larval development. If a tree is sawed into boards, it is still susceptible to the same attack. Man attempts to disguise or embellish the wood he uses by painting it or covering it with various metallic materials or bricks, or by treating it with chemicals which add resinous or fungicidal materials to increase its decay resistance.

All of these attempts at disguising wood are fairly successful, but temporary. If paint peels away exposing untreated wood, some kind of wood-damaging pest may attack it.

INSECTS AND MAN COMPETE FOR WOOD

Both man and insects use wood, which means there is competition for it. When insects in the forest turn a fallen tree back into soil, they are of no concern; but when that fallen tree produces boards for a house and the same insects invade it, the competition becomes obvious. The "beneficial insects" become "pests."

A massively built pioneer structure made of whole logs could last 100 years with even ceaseless eating of many insects. Today, however, we use a beam that is only as large as we need. The life expectancy of a modern house is relatively short compared to that of a log cabin; however, our forests would already be gone if whole logs were used in place of boards. If the modern house is well kept and periodically protected with various materials, it, too, can last a long time.

TERMITES AND OTHER WOOD-DESTROYING ORGANISMS

Some wood-destroying organisms use wood for food, others do not. Some excavate the wood to make shelter for either laying eggs or escaping from adverse weather. Termites actually eat wood; for them, it has nutritional value.

The source of subterranean termites is the soil. This termite must maintain contact with the soil to get needed moisture. (Drywood termites do not require soil-wood contact and can survive in wood with a normal low moisture content, but they are not common in New Hampshire).

Some beetle larvae attack living trees. When these trees are sawed into lumber for construction, the larvae may continue to develop if the timber is not chemically treated. Damage is slight, because adult beetles emerging from the structural timber will usually return to living or dead trees to deposit their eggs.

Some species of beetles will reinfest the lumber or timbers from which they emerged. Thus, the larvae will continue to breed and bore in the wood and weaken its structural strength.

Carpenter ants and carpenter bees chew holes and galleries in wood. The bee prepares galleries to house its developing young, and the ant excavates extensive galleries which house whole colonies of this species. These insects do not eat the wood.

Another group of organisms which can be present in structures is wood-destroying fungi. Fungi are plants which contain no green chlorophyll, a chemical necessary to produce plant nutrition. They extract the chemical energy stored in dead or dying plant matter. Wood cellulose stores much energy and is a prime target for the growth of decay fungi.

Control of the several kinds of wood-destroying organisms is based on some relatively simple concepts. To prevent termites in structures, they should be built so no wood contacts the soil. Since few structures are built carefully enough to prevent termite invasion permanently, selected chemicals can be applied to the soil before a structure is built, to effectively form a repellent barrier between the soil and the wood.

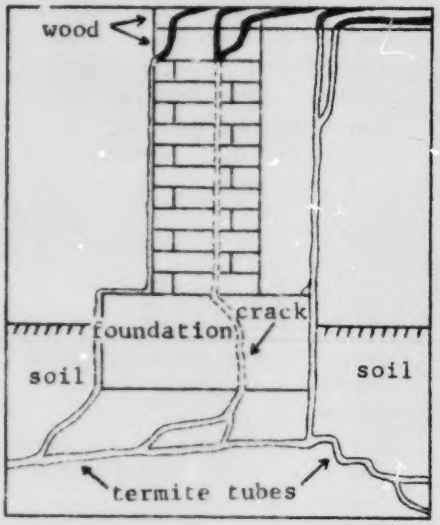
Treatment against wood-infesting beetles or fungi relies on making the wood unsuitable for the organism. Wood may either be chemically dipped or treated before the structure is built, or may be treated chemically after an infestation is discovered.

For those excavating insects such as the carpenter bee and carpenter ant, local treatment to remove the particular infestation will usually suffice.

HOW STRUCTURES GET INVADED

When building contractors remove trees and then erect houses, certain wooden structures often penetrate the soil. This makes an open invitation to the soil-dwelling termites to feed upon the structural wood.

Housing contractors can chemically treat soil beneath the proposed houses, creating a barrier through which termites cannot penetrate. Unfortunately, many builders feel that house buyers are not willing to pay the price for this extra protection, and most buyers will gamble that termites will not invade their houses.



CONSTRUCTION ANATOMY AND FAULTS

The pest-control operator must gain a working knowledge of structural problems if he is to efficiently treat the pest invasion.

When inspecting for subterranean termite infestations, look for wood in contact with the soil or any hidden route by which termites can go from the soil to the wood through their protective shelter tubes. Where wood contacts earth, the termites can attack the structural timber in the same way they attack forest trees.

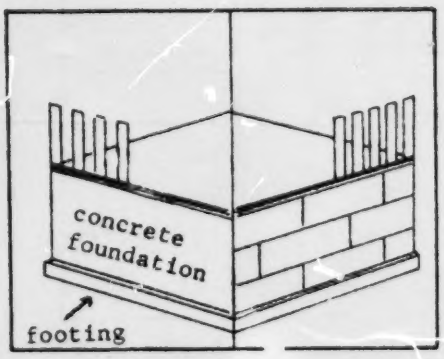
SOIL TYPES

Termites prefer moist soil so they do not dry out; but they cannot survive in soil which is saturated with water. The three general soil components--sand, clay and silt--in about equal proportions, should be present if termites are to thrive. Soil that is too sandy will be too dry; furthermore, termites cannot make tunnels of sand alone. Too much clay allows a soil to hold too much water. Soil composed of mostly silt will be either too wet or too dry depending on the rainfall.

Houses can be built on rock. Rocks often have cracks or fissures through which termites can build tunnels from the soil beneath. Houses with a rock base are difficult to treat because there is no soil beneath them that will retain a chemical toxicant. Therefore, the fill and the wood structural members in contact with the rocks must be chemically treated.

When a termite operator considers the soil and its components, he must also consider the amount of wood already in the soil. Conscientious builders generally pull out tree stumps as they clear land. Hasty builders may leave stumps and build over them if they are not in the way. A tree stump provides food for termites for several years. (In 3 to 5 years after an inferior housing development has been completed, residents will probably start to report termite swarms in their houses. Perhaps some of the homes will have already been attacked and damaged slightly.)

FOUNDATION FAULTS



POURED CONCRETE CONCRETE BLOCK

Foundations are an important construction feature. Poured concrete foundation walls are the most sturdy and lasting, but they cannot be completely solid because of built-in expansion joints. These are usually filled with tar and fiber mixture, and are the places through which termites can enter. The expansion joint is a necessary feature and not a fault of the poured concrete foundation. If, however, the joints are filled carelessly or hastily, it is a fault. Termites need only 1/32 inch through which to build a tunnel.

When the builders pour a concrete foundation, they do so by building a wooden form and then

filling it with concrete. If a form board is not removed, it may serve as the connecting link between the soil outside and wood materials inside the dwelling.

The most common type of foundation used in medium-priced homes and development homes is the concrete block wall foundation. Disadvantages of the block wall include the hairline cracks which may develop between the cement and blocks of the wall, and the network of hollow spaces between the inner and outer face of the wall. Every hollow void in the top course of blocks should be closed with either cement or a capstone. Even then, if it is not installed properly, termites can gain access to the sillplate or mudsill, the first member of the wooden super-structure.

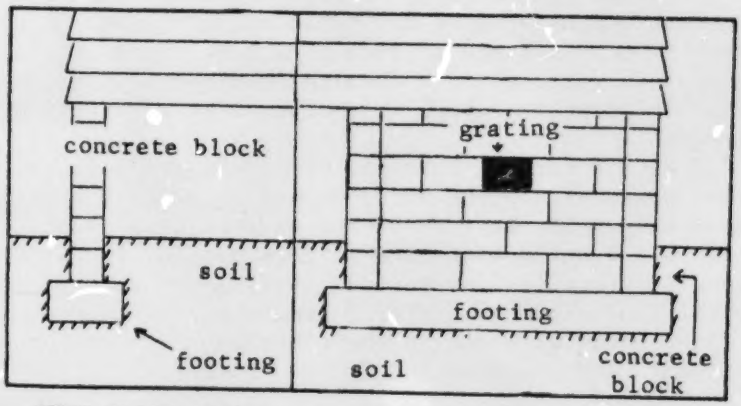
A foundation type which is less commonly seen in new construction, but might be encountered in older houses, is the rubble foundation, (Naturally formed rocks or boulders are fitted into place and secured with mortar.) This is a very stable foundation wall, but voids may occur between stones which are not completely sealed. These can serve as entrance points for termites.

THREE BASIC HOME CONSTRUCTION TYPES

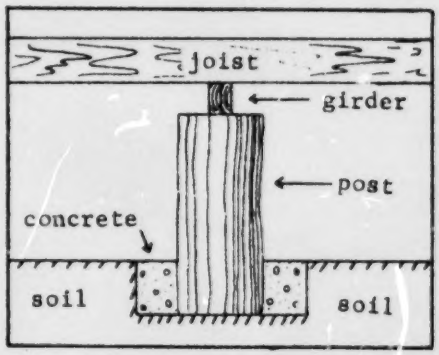
Homes can be constructed with a basement, with a crawl space, or with neither (a slab on ground). Each of these construction types presents its own special problems.

Crawl space is either open or enclosed. In both crawl space types, the flooring requires some support, usually in the form of steel jack posts, concrete block piers, rubble piers, or even worse--wooden piers. Termites can construct their tubes from the moist soil of the crawl space.

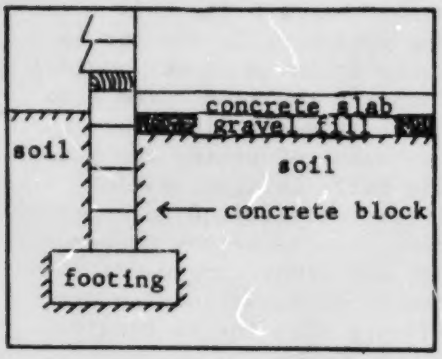
In a home with a basement, even if the foundation is constructed properly, termites may invade because of negligent landscaping. The soil should never be closer than eight inches from the nearest wood of the super-structure.



OPEN CRAWL SPACE CLOSED CRAWL SPACE



CRAWL SPACE WITH WOODEN PIER



CONCRETE SLAB-ON-GROUND

The disadvantages of slab-on-ground construction is not that it is a concrete slab, but that the slab is located in direct contact with the wooden members of the structure.

Even though poured concrete is a rather strong material (even stronger when it is reinforced), it is still subject to the forces of the earth which may produce tiny cracks in the concrete or separations of the built-in expansion joints. Either of these two situations facilitate termite entry.

WOOD ABOVE THE FOUNDATION

The horizontal board which is on top of the foundation wall, to which the rest of the house is attached, is called the mudsill. This is a critical part of the house and the one most often infested. Vertical timbers resting on the mudsill are called studs. Studs are held to one another by braces and by sheathing or subsiding.

The outside wall (subsiding) is attached to the studs and covered with siding. The inside wall (lathe and plaster or wallboard) is also attached to the studs. This leaves an empty space between the inside wall and the outside wall; it is called a wall void. Some houses have wall voids filled with insulation; others have empty wall voids.

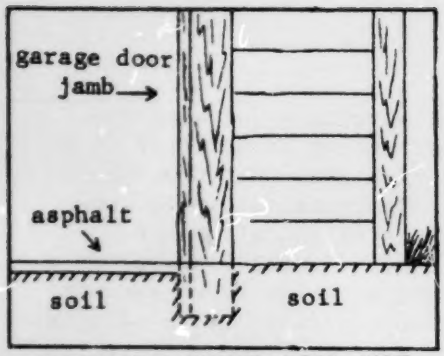
In basement homes, joists are the large planks which run from the top of the foundation wall on one side to the top of the opposite wall. Joists are held in place by cross braces, and the subfloor is usually nailed to the tops of the joists. The finish floor is then applied to the subfloor.

The detailed arrangement of mudsill, joist, and stud often varies from state to state, from builder to builder, and depends in part on the cost of the dwellings.

Joists are particularly susceptible to termite damage because of their nearness to the foundation wall. Joists and mudsills are probably the most extensively damaged members in an infested structure. These members are particularly expensive to replace correctly since they are such basic members of the structure. The house must be raised and supported by jacks, so that new wood may replace the severely damaged portions.

In cases where the wood of sills or joists are not damaged to the point of structural unsoundness, chemically pressure treating the wood can kill the termites, halt their advance, and preserve the structural value that remains.

Since it is the grain and resin content of wood that determines its structural strength, and since termites eat only those portions of wood between the grain, sometimes the damaged wood can be left in place and still maintain much of its strength. But it takes an expert to judge whether to leave damaged wood in place or to replace it.



INCORRECT GARAGE DOOR JAMB

Garages, since they are not living units, are not as carefully built as houses. Often the concrete floor is poured after the wooden walls are partly built, leaving the frame in direct contact with the soil beneath the slab. The same hazard occurs when basement floors are poured after the basement stairs are built. When incorrectly built garages, patios, porches, or stairs are attached to a carefully built house, the house may become infested through any connecting wood. Structures as small as boxed-in planters, fences, or trellises also invite termite invasion.

Window wells in basemented houses are popular features in many modern houses. Window wells infrequently have finished bottoms, creating another instance of soil close to wood. Even though metal basement window frames have replaced wooden ones, debris collected in window wells can give termites the cover they need to make entry into a structure.

SUBTERRANEAN TERMITES

Of the many organisms which weaken the soundness of wood, subterranean termites cause more damage to buildings in the United States than any other insect. Pennsylvania is within a region of moderate to heavy termite infestation.

The termite species commonly dealt with in Pennsylvania is the eastern subterranean termite. In southeast Pennsylvania, infestations of a southern species, the Virginia termite, have been reported. Control methods for the two are essentially identical. Drywood termites have been found occasionally in Pennsylvania, but were probably brought here inside furniture or other wood products from the South. They require different control methods.

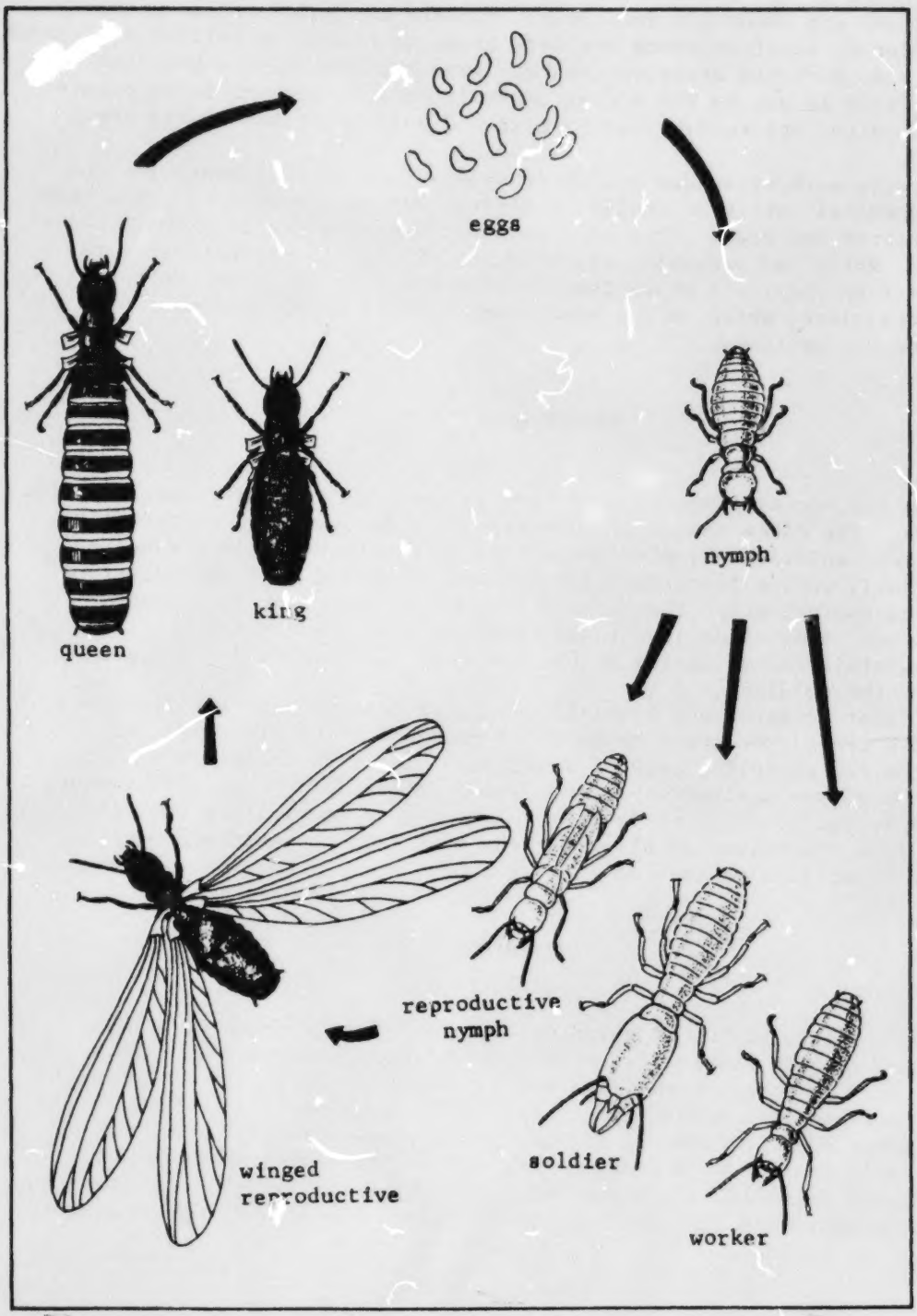
DESCRIPTION

Sexually mature adult termites have wings attached to the second and third segments of the thorax. Termites have 6 legs, one pair attached to

WINGED TERMITE

9 WINGED CARPENTER ANT

EASTERN SUBTERRANEAN TERMITE LIFE CYCLE



each thoracic segment. The abdomen of a termite is about the same width from front to rear. (Flying ants have a constricted waist.)

Swarmers of the subterranean termites are about 1/2 inch long; workers and soldiers are about 1/4 inch long. Workers and soldiers are creamy-white colored; adult swarmers are dark brown to black. A soldier may appear to have some darkened areas on its head near the base of its powerful mandibles. This is due to the strong exoskeleton structure at these points. Worker termites are soft-bodied insects and only their mouthparts are hardened.

Termite workers seldom use their eyes. They rely on sensations of sound, chemical tastes or smells, humidity, and temperature to guide them.

Termites eat wood. They have in their guts one-celled animals called protozoa, which can partially digest wood. The waste products from the protozoa form chemicals which the termites can digest. Termites cannot digest cellulose, which is the major component of wood; they must have help from the protozoa.

SOCIAL BEHAVIOR

Termites are social insects; they live in caste (class)-structured colonies or nests. The three castes of subterranean termites are: reproductive, worker, and soldier. Single termites do not survive. From the nests in the soil, worker termites build tunnels to buried wood (cellulose) or to the surface where they find wood such as a tree or in a house.

Worker termites do just that: find and eat wood, construct the nest, maintain the galleries within the wood, groom and feed the queen, and feed the soldiers.

Soldier termites are specially modified sexually sterile individuals. They have greatly enlarged heads which accomodate the large muscles that power the two swordlike pair of mandibles. It is the soldiers' job to guard the colony against invasion. The soldiers do not eat wood because their jaws are too big; in fact, soldiers are so specialized that they cannot feed themselves at all. Workers must feed the soldiers on regurgitated food, just as they do for the queen.

SWARMING

The queen's life begins at swarming time when several batches of eggs hatch into nymphs which eventually become winged reproductives. (Termites normally swarm in March, April, and May in Pennsylvania.)

The swarm is a mating flight and as the termites fall to the ground after their short fluttering flight, their wings break off. A male and female will search out a crack or crevice in the soil or near wood.

Once a pair find a crevice and seal themselves in, they mate and the queen begins to lay eggs, only a few at first. Once these worker-nymphs hatch, they begin to eat cellulose products and enlarge the colony area.

With a larger number of nymphs, the queen will lay increasingly large numbers of eggs. It takes 2 to 3 years for a newly established colony to begin to do serious damage to structural wood.

Termites are active all year (though egg laying slows in the winter) and can be detected and treated during any month, provided the ground is not frozen.

Termite nests deep in soil are seldom seen; the workings of termites in structural wood are more obvious.

Termites work with the grain and eat out only those portions of the wood which are relatively soft and resin free. Termites leave the hard resinous portions which make the rings of trees or the grain of lumber. The termite-damaged portions are referred to as galleries, which contain frass (waste from undigested wood). Subterranean termites usually pack their frass into unused portions of their galleries, but they sometimes neglect it. Frass is that portion of the termite workings which, if left unchecked in a natural environment, is destined to become soil or humus from which other plants derive nutrients.

Most species of termites that damage structures excavate the wood from the interior of lumber and leave only a thin layer of wood between them and the exterior. Wood damaged to this extent usually must be replaced. Termites will often be noticed before they have the beam entirely hollowed out. In this case, treatment of the beam to kill the termites will prevent further damage, and the beam may still have enough structural strength to hold up the house. The resinous portion of wood gives it its structural strength. As long as that remains intact, it will do its job of support even if some of the surrounding soft wood cells are removed.

Termites get from one place to another through tunnels and tubes. When they move through soil they build tunnels. If they must move over a surface, they build a tube from dirt, frass, sand, or debris. Connecting tubes help maintain the humidity and protect the colony from outside invaders so the termites can work safely.

CARPENTER BEES

CARPENTER BEE

Like the carpenter ant, the carpenter bee excavates wood in which to lay eggs and raise its young. Carpenter bee damage is usually not extensive but it occurs in such a way that a little damage may be too much.

The first visible damage in the wood is a small hole about the size of the diameter of the female bee (1/2 inch). This hole usually penetrates about 1/4 inch, then turns at a right angle and proceeds along the grain of the wood, forming the egg laying gallery. When galleries are used year after year, the bees excavate new branches or extend the old galleries. This can create structural damage.

Carpenter bees look like bumblebees; they are fuzzy and black, with yellow hairs located on the thorax. (Bumblebees have a fuzzy black abdomen, but the carpenter bee's abdomen is hairless on the upper side.)

BUMBLE BEE

HORNTAILS

One of the most spectacular wood-boring wasps is the horntail, about 1 inch in length with long ovipositors. Horntails neither bite nor sting.

HORNTAIL

In forests, horntails lay their eggs in weakened trees, where the larvae remain for up to 3 years. Then they chew their way out of the wood, whether it is still in the forest or built into a house. They will not lay any eggs in the wood of the house.

BEETLES THAT INFEST WOOD

Wood-infesting beetles are a major group of pests associated with wood and may be divided into two groups: 1) those which are nuisance pests and do not cause continuing structural damage, and 2) those which reinfest wood and must be eliminated to maintain structural soundness.

LYCTID

Lyctids

The larvae of the Lyctus (powder-post) beetles damage sawed hardwood timber and furniture. The adults are small, flat, and elongated.

The larvae, as they bore through the wood for nourishment, cause the actual damage. Wood-destroying lyctids cannot digest cellulose, but can eat and digest the starch content of the cellulose in wood.

The more starch there is in the wood, the faster the larvae will develop and the less damage they do to the wood. If there is a low starch content, the larvae have to move further through the wood to find the needed starch to eat.

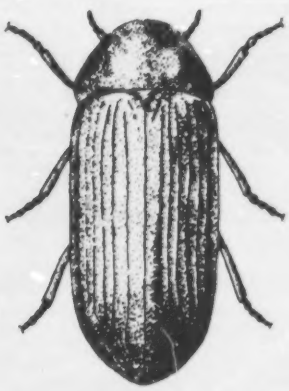
Powder post beetles are small, and many larvae can live in a small piece of wood. When they emerge in a group, they give the wood the appearance of having been shot full of small holes (1/32 to 1/16 inch in diameter). Holes on the wood surface signify that internal damage has already been done.

Lyctids prefer the hardwoods, and ash is particularly susceptible to damage. Finishing the wood with a varnish or lacquer to fill the pores and crevices will discourage further egg-laying activities.

Bostrychids

Another family of wood-dwelling beetles is the bostrychids. Adults of this family are larger than any of the lyctids; a typical bostrychid is about 1/2 inch long, though some species are as large as 1 inch. Bostrychids are cylindrical and compact.

Bostrychid females bore into the wood and lay eggs inside. Like the lyctids, bostrychids depend on the starch content of wood. The exit holes of bostrychids are slightly larger than those of lyctids (1/8 to 3/8 inch in diameter). Larvae tunnels are full of fine frass which can be shaken out if the wood is tapped or moved.



Furniture Beetle

The furniture beetle is a very small (only 1/10 to 1/5 inch long), dark-red to dark-brown cylindrical beetle.

The furniture beetle attacks both hard and soft woods. The female lays eggs on the surface, and when larvae hatch they begin to bore through the wood. This species, unlike the others, can eat and digest cellulose.

Exit holes of the furniture beetle are slightly larger than those of the lyctids (1/16 to 1/8 inch in diameter).

In addition to powdery frass in the tunnels, there are usually some bun-shaped pellets.

To control these wood-infesting beetles, the most satisfactory method is surface treatment with an insecticide in an oil solution to penetrate the wood. Oil-based insecticide sprays will be satisfactory in some instances. Finishing the wood with a varnish or lacquer will prevent further egg-laying activities.

Old House Borer

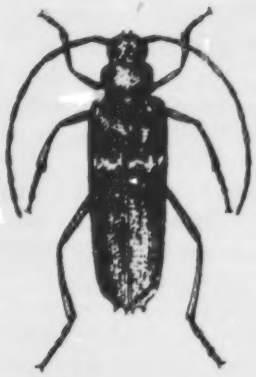
The old house borer is a large (1/2 to 3/4 inch), slightly flattened beetle with greyish hairs on the head and forward portions of the thorax.

Larvae of the old house borer digest cellulose and can riddle seasoned sapwood of softwoods (conifers). They pack their tunnels tightly with powdery frass. Adults emerge from oval exit holes that are about 1/4 inch across, and lay eggs on the surface of the same wood from which they came. In this way, even some rather large timbers can be greatly weakened. Though this pest was originally found in very old homes built of large beams and rafters, it is now known that the old house borer may be found in any building more than 5 years old.

OLD HOUSE BORER

WOOD-INFESTING BEETLES REQUIRING NO TREATMENT

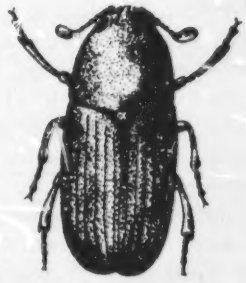
The first job of the pest-control operator is to identify the problem and the related insect. He must determine which treatment will be the most effective and best for the customer. Correct identification must include those insects for which no extensive treatment should be prescribed.



FAMILY--CERAMBYCIDAE

Many members of the family to which the old house borer belongs can be found in firewood and will be carried inside. The many species in this family all have long antennae, and most have bright spots or lines on the wing covers. The old house borer is the only member known to cause any extensive damage inside dwellings. No other members should require any exhaustive whole-house treatment since they attack trees in the forest.

Another family which does superficial damage to wood is the scloytids. The family includes bark beetles or engraver beetles and ambrosia beetles. Bark beetles are small (1/8 to 3/8 inch) and cylindrical. They are easily identified by the characteristic tunnels they make, with a central chamber and many small radiating tunnels over the surface of the wood beneath the bark and on the bark underside. The tunnels do not go deeply into the wood; they are engraved on the surface of sapwood.



SCLOYTID

Bark beetles do little damage to any seasoned lumber, only to trees with bark still intact. These beetles may emerge from firewood inside a house but they will not harm the building.

Ambrosia beetles also attack trees and are often in lumber that goes into a building. The larvae tunnel directly into sapwood and heartwood. Their tiny tunnels do not lessen the structural strength of timber, but they can cause concern when a homeowner sees their blue-stained tunnels. A fungus that grows in abandoned tunnels causes the stain, which is harmless. Proper wood curing removes the moisture needed by the tiny fungus and stops its growth. Ambrosia beetles are mentioned not because they are reported emerging inside homes, but because homeowners may be concerned about the stained tunnels they find in lumber they buy.

Metallic wood borers, in the adult form, have shiny, iridescent exoskeletons. The larvae are flat-headed. Infestations are most often found in firewood.

Pest control operators will sometimes find damaged wood when treating for stored-products pests. The cadelle beetle and the larder beetle larvae will bore a few millimeters into the wood of the pantry shelf to pupate. Later the adults emerge and leave a hole. It causes no structural damage, and the concern should be directed at removing the infested stored products.

WOOD-DECAY FUNGI

Fungi may be found in nearly all structures in the United States, though these plants are most damaging in states with constant high temperatures and high humidities. Fungi damage buildings in the northern states, but here the damage is often limited to a specific part of the structure with a high-moisture condition.

Even though few pest control operators perform fungus-control services, they must be able to recognize fungus-damaged wood and make recommendations.

MAJOR TYPES OF FUNGI

The two types of fungi that cause structural wood decay can be distinguished by the numbers of spores they produce and the way they produce them. The two

groups are called Basidiomycetes and Ascomycetes. The basidiomycetes produce spores on a structure called a basidium; four spores are produced from each basidium. Ascomycetes produce eight spores in each ascus, a tiny sack.

Fungi associated with wood rotting are members of the group basidiomycetes. The spore-producing structures called fruiting bodies are important for identification, but the structures of the fungi which do the damage are the tiny root-like structures called mycelia. A single mass of mycelium is composed of many tiny roots, or hyphae.

Each hypha penetrates dead cells and secretes chemicals to digest the nutrients which are then taken into the hypha and transported back to the main body of the fungus. Fungi may be active for several years before any fruiting bodies are produced to identify their presence. The best way to discover and correct fungal infestations is to know the conditions under which these organisms thrive: All that is necessary is a source of food (some wood) and moisture to permit spore germination and growth.

Some examples of favorable conditions for wood-rotting fungi are:

- -dripping faucets, especially when they drip onto wood;
- -leaking downspouts on wooden siding;
- -defective eaves and gutters;
- -automatic lawn sprinklers directed at a building;
- -defective plumbing (toilets, tubs, stall showers, sinks, etc.);
- -condensation of soil-water vapor onto joists in a damp basement or in crawl space;
- -defective flashing about chimneys, vent pipes, dormers, etc;
- -capillary action, the movement of water through very small spaces. (Water can move from moist soil into a brick or block wall and be drawn upward through pores in the foundation into the lowermost portions of the wooden superstructure.)

Most decayed wood, discovered after the fungus has done its work and disappeared, will look dry and cracked in cuboidal ("squarish") chunks, and will have little or no structural strength.

CORRECTIVE MEASURES

Measures which may be taken are similar to those to prevent or correct moisture conditions conducive to subterranean termite infestation. If the building has a crawl space with moisture from the soil condensing on joists and subflooring, a vapor barrier may be installed. A vapor barrier may be either heavy roofing paper or 6-mil polyethylene spread over the soil surface. Moisture from the soil will then condense below the barrier instead of on the vulnerable wood.

If ventilators are not present in crawl space they should be installed. For each 25 linear feet of foundation wall there should be no less than one square foot of open space. The best air circulation is achieved with ventilators opposite each other on the crawl space walls and unobstructed by plants or ornamental structures.

If wood is already infested with rot fungi, replacement is usually the best course of action. The old, obviously damaged wood and any apparently undamaged wood for 2 feet on either side of the damaged portion should be removed. (Microscopic hyphae may be present in the adjacent wood, and 2 feet is considered the margin of safety.) Replacement wood should be pressure treated before being installed.

INSPECTION FOR WOOD-DESTROYING ORGANISMS

A proper inspection is critical for a termite control operator. It determines whether or not there is a job to be done, and if so, which areas will require special treatment and which approach to use. Damage found by the building owner may be only a minor exposed part of the total infestation.

MATERIALS

Some tools and materials needed for a good inspection are:

1. A strong flashlight or electric lantern (spotlight).
2. A clipboard, tape measure, and paper--graph paper helps make an accurate sketch of the structure.
3. Pencil and marking crayon or chalk. The pencil is for making sketches and notes--the chalk or crayon is for marking places on the structure or timber which may need special treatment.
4. Probes, such as an icepick, screwdriver, or penknife, to test wood soundness.
5. Appropriate dress for crawling in and under the structure. Always empty pockets of unnecessary items before entering a crawl space.

STEPS IN MAKING AN INSPECTION

First, survey the outside of the building and the grounds. Make a sketch of the exterior foundation walls to scale. Mark on the sketch any unusual conditions on the lot, such as a firewood pile too close to the foundation wall; note any tree stumps or other wood debris. Observe drainage from the gutters and downspouts; see that water is carried away from the structure and does not wet the foundation wall or puddle in the yard. Look at the siding for rainwater stains or rust. Observe siding nails to see if they are rusty. Observe vegetation which may surround the structure and see if it will cause any problems when the men come to treat. Check

to see if cap blocks have been installed on the last concrete block course. If not, there may be considerable chance of termites entering through the hollow blocks.

Observe attached porches and fences, trellises, garages, or carports which could transfer termites to the dwellings. Look at trees on the lot. Do they touch the building at any point? Observe the foundation wall. Look carefully for evidence of mud shelter tubes from the soil to the wood beneath the siding. Be alert to cracks in the foundation wall. Note where utility conduits enter the building below the soil line. Too often installers simply smash through a block wall and do not reseal the opening. Check this spot thoroughly from the inside.

If the structure is in a rural area, take note of the water source. If it is a well or cistern, special precautions must be taken to avoid contamination of these water sources with chemicals. Examine the soil to be certain that it does not contain too much clay (which would not absorb water-borne chemicals) or too much sand (excessive water would wash away chemical protection). Take note of patios or porches which may require drilling with electric or air-hammer drills. Porches or stoops must be examined closely to determine if they are filled with dirt and/or wood debris. (The latter is often the case with so-called modern construction.) See if concrete from porches or patios laps over siding or wooden foundation members; this may be an entrance point or a decayed area.

THE BASEMENT

After thoroughly checking the outside of the building, proceed to the basement. Check the foundation wall for cracks. Observe the floor. If it is concrete, are the expansion joints intact; are there any other cracks in the floor? Look at the basement door. Does the door frame extend into the concrete? Do the basement stairs rest on concrete or do the stringers extend into the concrete? Are there other wooden structures in the basement, such as a coal bin, which might have wood-soil contact?

Take particular note of the furnace. Is it placed in such a way that it warms the soil beneath the slab or the soil outside the foundation wall? Give particular attention to wood members in these areas.

If the basement is finished into a recreation room with wood panelling, and if you find termites elsewhere, you must suppose that they are in the wood behind the family-room panelling. Inspecting behind panelled walls is costly since the panels must be removed and replaced.

If the basement is finished, chances are that the automatic washer and dryer are there. These heat sources may attract termites beneath the slab, so make certain that the concrete is not cracked there. Pay careful attention to any bathrooms which may be located in the basement. Leaky faucets or pipes will add to the moisture termites need for survival.

THE BASEMENT CEILING

Check areas under first-floor plumbing. What is the condition of the sub-

floor beneath the kitchen (sink, refrigerator, dishwasher, stove), and beneath the bathroom (commode, tub, shower stall)? Too much moisture in these areas can lead to decay as well as to termite infestation. Look at the junctions of joists to the mudsill. These are critical places of potential damage to flooring.

LIVING AREAS

When you begin to check the first floor of the living quarters, give particular notice to any clues which the exterior and basement inspections have given. Observe the walls with common plumbing fixtures (bathrooms are often adjacent to kitchens). Check tubs and showers for loose tile and fixtures which would permit water to leak into the wall. You may get a better view of behind-wall plumbing through access hatches which are often located in adjacent closets.

Carefully inspect the front and back doors to see that the frames are intact, or if a stoop overlaps a siding or sill, hiding a possible termite entrance point. Check inside window frames to be certain that no water leakage or condensation has occured. Look at baseboards and check their soundness by probing, especially near or above areas which the basement inspection has indicated as particularly hazardous.

CRAWL SPACE

If the building is constructed with a crawl space, this area must be carefully inspected. A look at the interior walls will reveal any mud shelter tubes. Crawl spaces usually contain floor-support posts. Check to see that these are constructed with no direct soil-wood contact. Supports should be built on concrete piers. Inspect the support posts for mud shelter tubes. If the support post is all masonry, check the wood joists and the subflooring above the post for damage.(Termites may have come up through the center of the post.) Give attention to any waste-water pipes coming through the crawl space; special treatment is required around such pipes.

Look at all subflooring in the crawl space for excessive condensation from soil moisture. Crawl-space soil may contain old lumber scraps or partly buried tree stumps; these items should be removed if possible and the space cleaned. If the crawl space already has a plastic vapor barrier, see if it has punctures. Check to see if there are any termites in the moist soil beneath the barrier; this indicates that they might eventually get into the structure. If the foundation wall is made of concrete block, probe the sill of the house from the inside of the crawl space to be certain that no termites have invaded it through the hollow block voids. This should be done even if the blocks are capped, for caps can break or separate to make hairline cracks through which termites may travel.

When you leave the crawl space, double check to be certain the areas inspected inside the structure match the dimensions of the sketch or the outside. Sometimes houses are built with hidden or dead areas. When additions are made on houses, it is not uncommon for builders to construct a bearing wall for support through the middle of the crawl space and leave no access to the other half of the crawl space. In this case, the termite operator must smash the wall and create an access for a complete inspection and treatment.

USING PROBES

The purpose of pointed objects is to probe wood to see if it is solid or damaged. The probe should be applied with enough pressure so the point breaks through infested wood, but not so much that the point defaces sound finished wood. When wood is finished well, the sound of the taps on the wood reveals whether it is infested.

A screwdriver can be used as a probe, but a probe should not be used as a screwdriver. That is--a screwdriver is often used to remove baseboards so the wood behind can be viewed; but if the baseboard were removed with an icepick, it would probably leave dents and scrapes in the wood. Undamaged wood removed for inspection should be replaced in the same condition.

PRESENTING A PROPOSAL

Termite damage is not considered an immediate catastrophe, and income tax officials do not permit deductions for repair of gradual damage as they do for lightening or storm damage.

Inspection and selling are best done by one man. Salesmen who do not inspect houses may have had to learn how to inspect, but they do not know all the problems of the dwelling where the job is to be done. Their primary job is selling, and they often may be unaware of the peculiarities of the dwelling and homeowner.

GENERAL PREVENTIVE AND CORRECTIVE CONTROL MEASURES FOR SUBTERRANEAN TERMITES

The termite-control operator's job is not simply one of killing termites, but rather one of protecting structures against attack by termites. Many people believe that a monolithic concrete slab (a slab plus foundation poured all at once) is impervious to termites. It is not. Expansion joints and tiny cracks that develop because of soil shifting permit termite entry.

The main objective of all chemical termite control is to place a barrier into the soil under and around a structure so that the termites will be killed or repelled by the toxicant. This is relatively easy to do before a structure is built.

Pre-construction termite control treatment is simple and inexpensive. The insecticide is applied on and around the site of the structure, in the soil, and on the foundation. The advantage of pre-construction treatment is that the chemical can be applied more accurately, more conveniently, and without the labor normally involved in preparing and treating a completed building.

For soil pretreatment, a chemical must be selected and diluted to the proper concentration and a specific rate of application must be followed. Pretreatment requires that the applicator know the dimensions of the building, because application rates specify a certain amount of active chemical for each linear foot of foundation wall, or for each square foot of soil surface.

STEPS IN POST-CONSTRUCTION TREATMENT

The objective of post-construction treatment is the same as for pretreatment: to place a chemical barrier between the soil and the structure to protect the house against further attack by termites. Corrective termite control usually takes four steps:

1. Replacement or repair of damaged wood
2. Soil treatment with termiticide
3. Foundation treatment
4. Wood treatment at the lowest portions of the structure

These four steps were laid down by the National Pest Control Association in its Approved Reference Procedures for Sub Termite Control.

Termite operators in Pennsylvania do not usually maintain their own team of carpentry specialists to do wood replacement. Instead they remove infested and unsound wood, and either subcontract the carpenter, or advise the homeowner to choose his own carpenter.

Wood in contact with soil should be raised onto a concrete surface or onto a concrete post to separate soil from wood by at least six inches. Wood which may still be susceptible to termite attack, even after replacement, may be pressure treated to protect it. Some infested wood may have enough structural strength for the needs of the building, even if some of the sap-wood areas have been damaged.

SOIL TREATMENT

Soil treatment is the placement of insecticides around the interior and exterior walls. Operators have several options for getting the insecticide into the soil. An effective and economical method is rodding. With a long, hollow steel rod, the chemical can be injected into the soil to the desired depth at proper intervals along the wall. An alternate method of rodding is using a steel punch bar to create holes in the soil to the proper depth; the insecticide is then poured into the holes and allowed to soak in. The most primitive method of soil treatment involves digging a narrow trench around the foundation and then applying the chemical to the soil as the trench is refilled.

BASEMENTS

While rodding is relatively easy on the outside of the foundation wall, it is impractical in the basement or in a crawl space. The basement floor is near the level of the footing so the depth advantage of a long rod is unnecessary. In a house with a crawl space, long rods cannot be taken into the small space and used effectively.

In basements, the soil beneath the slab inside the foundation wall should be treated along its perimeter. To do this, holes must be drilled through the basement floor about 6 to 8 inches from the wall and approximately 18 inches apart. The distance between holes should, however, be based on the soil type and the expected amount of chemical spread through the soil.

The spread of chemical is a critical point. If the soil is porous, chemical injected under 80 pounds of pressure may spread from 6 to 10 inches from the hole where it is injected. Obviously then, the next hole needs to be 12 inches from the first for the spread to meet and give continuous chemical protection beneath the concrete. Sandy soils permit more spread than silty soils; clay soils offer least spread; dry soils permit more spread than do moist soils.

Basemented homes may have screeds--wood imbedded in the concrete floor. They are designed to anchor a structure such as a partition wall or coal bin. A screed is usually a two-by-four laid on its side; it may have had bolts in it before the concrete was poured. A screed, in essence, reduces the thickness of the concrete by two inches where it is installed. Cracks may occur, allowing termites to come directly through to the screed and from there into the partition wall or coal bin. For this reason, basement partitions must be given special attention during inspection and treatment. Where there are no screeds, there may be anchor bolts imbedded into concrete floors. Such anchor bolts also increase the tendency of the concrete to crack at those places where they are installed. Anchor bolts attach to wood, and such a crack would give a direct route for termites into basement supports or walls.

CRAWL SPACES

Inside crawl spaces, operators generally make small trenches and use an ordinary nozzle to flood the soil in the trench. Debris on the soil surface of crawl spaces should be removed. If there is not already 12 inches of clearance from soil to the nearest wood, the soil should be excavated. (Termites can easily traverse a gap less than 12 inches with tubes and no external support.)

When crawl spaces are constructed where the soil slopes down from the foundation walls and slab, rodding is used to treat the soil under the slab from the outside. Here, instead of pushing the rods straight down into the soil, the rods are pushed under the slab horizontally so that the chemical is placed in the top layer of soil. This eliminates the delicate drilling job inside the house. This method works only where the soil is either level and below the grade of the slab, or where the soil slopes down and away from the house.

SLAB-TYPE CONSTRUCTION

In homes where heat pipes and ducts are embedded in the slab, another problem is presented if the interior perimeter must be drilled. Copper pipes are commonly used to carry hot water as a source of heat in some homes. Other homes have forced-warm-air ducts imbedded in the slab. In either case, termite operators must avoid puncturing the copper piping or the hot air ducts. As a precaution, the heating system should be turned off and the pipes drained before any drilling is done, and drills should have special attachments so they stop automatically when they contact metal. If holes are accidentally drilled in ducts, termiticide liquid will enter the ducts, spreading the odor through the building.

FOUNDATION TREATMENT

Poured-concrete foundation walls are solid and need not be treated; only the bases need to be treated. Sometimes chemical can be dribbled into any cracks which appear in the solid concrete to prevent termites from using the cracks.

The most popular foundation wall type at present is the hollow concrete-block wall. Most concrete blocks are rectangular with two or three voids in the interior. Blocks are sealed to one another with mortar or cement, and the courses (or horizontal layers) are staggered so that the seam of a block joint is under the center of the block of the course above.

The goal of foundation treatment is to place the chemical inside the holes in the blocks so that it flows down and coats the interior of blocks in the courses beneath. This way termites cannot use the inside of the blocks as a highway to reach the wood which rests on the foundation wall.

In construction of inexpensive homes, workmen sometimes sledge-hammer their way through a foundation wall to bring through utility lines. Such holes or breaks should be resealed with dense cement, roofing grade coal-tar pitch (not asphalt), or rubberoid bituminous sealer.

There are two basic ways of treating a concrete-block foundation wall. Some operators drill one hole into the center void in every block of a certain course and pump in liquid termiticide. The chemical is divided at each course according to the way the void holes are staggered.

Still other operators prefer to drill holes at the mortar joints where one block is joined to the next. When they complete drilling, they will be at the void formed by the projecting ends of the blocks. Theoretically, pumping liquid into this hole should be the same as pumping liquid into the center void of a block, but if the bricklayer was generous with the mortar, the voids become sealed and will not allow the chemical to flow.

Inspection should indicate whether the block foundation wall has a proper capstone. Be certain that sufficient mortar was used to seal the capstone effectively. If not, it should be resealed, or the wood members of the sill plate should be treated. Occasionally, reinforced concrete is poured over the topmost hollow block course; this is an effective capping procedure.

WOOD TREATMENT

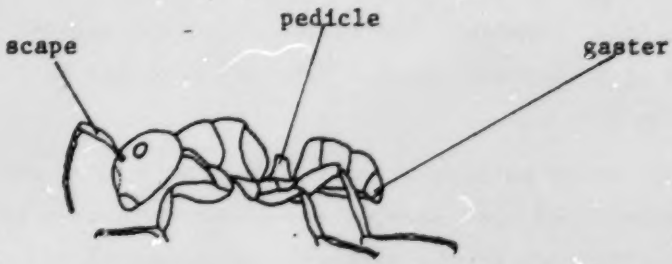
Wood treatment is considered optional by many pest control operators. If the soil is treated well, no termites will get to the foundation; if the foundation is treated well, no termites can get to the wood. Wood treatment is a third line of defense.

Lumber can be pressure-treated at the mill where it is cut by soaking it in pressurized vats containing special chemicals to render the wood resistant to both fungus decay and termite attack. Wood can also be treated when it is already in a structure; this is done by either (1) external application or (2) drilling and pressure injection. The first method uses a chemical to penetrate the wood. Wood can also be drilled with 1/4- or 3/8-inch drills, and then ordinary termiticide (in oil solution) can be injected under pressure into the holes in the wood.

When done properly, the four treatment steps of corrective termite control give protection which will last many years. A structure which has been treated is actually worth more because of the assurance that termites will not invade that structure for as long as the chemical protection lasts (provided, of course, there are no careless structural changes). Many people think that if a house is treated for termites it is worth less; this is not true. Treatment is value added to the structure, just as soil pre-construction treatment adds value.

ANTS

Ants are a highly successful group of insects belonging to the Order Hymenoptera, to which the bees and wasps also belong. They can be distinguished from most other insects by two characteristics: 1) The abdomen is comprised of a one- or two-segmented, freely moving node called a "pedicle" and the large posterior portion of the abdomen called the "gaster". 2) The antennae of ants are elbowed and the first segment (scape) is elongate.



Ants can be distinguished from termites, with which they are commonly confused, by the strong constriction or "waist" between the thorax and the abdomen, and the two pairs of wings, approximately equal in size with numerous veins. Termites have a tendency to lose their wings more readily than the ants. Termites also differ from the winged ants in that the abdomen is broadly joined to the thorax and lack a pedicle.

Carpenter Ant

Termite

There are normally three distinct castes of ants: Workers, Reproductive females, and Reproductive males. The male is generally winged, and retains its wings until death. Its size is usually intermediate between that of the worker and the female. The sole function of the male is to mate with the unfertilized female; when mating has been accomplished, the male perishes. Mating may take place in the nest, on the ground or in the air. Males are produced in old or very large colonies only, where there is an abundance of food, since much nourishment is required to bring males to maturity. After attaining maturity, the male usually does not remain long in the parental nest.

The Reproductive female, generally the largest of the three castes, normally possesses wings but loses them after mating. The primary function of the female or queen is reproduction, but in many of the more highly specialized ants, the queen also cares for and feeds the first brood of workers on her salivary secretions. She may live for many years; upon her death she is commonly replaced by a daughter queen. However, ants may have one or more queens, according to the species.

The worker, which is also a female, is never winged except as a rare abnormality. The workers of most species are of approximately the same size and structure. The function of the worker is to construct and repair the nest, feed the immature and adult of the colony including the queen, care for the brood, and defend the nest.

Ants may affect man adversely by infesting his house or buildings, where they may cause annoyance by feeding on food, or cause structural damage by their nesting activities. They mar the appearance of lawns, golf courses, and parks with their numerous and unsightly nests, steal seeds from seed beds, feed on seeds whether the seeds are germinating or not, defoliate plants, and gnaw into various parts of plants, especially roots and buds. They foster and spread other injurious insects such as plant lice and mealybugs, which in turn may injure the plant directly by their feeding activities or may spread a plant disease from an infected to a healthy plant. They may gnaw holes in various types of cloth, fabrics, and certain rubber goods, or remove the rubber insulation from telephone and electric wires, or damage the wiring of other electrical equipment.

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BUG FACTS

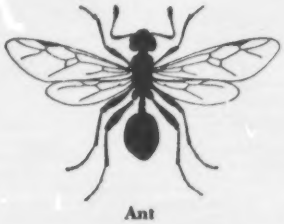
CARPENTER ANTS

J. S. BOWMAN

Extension Entomologist

Carpenter ants, along with termites are the most troublesome structural pests in New Hampshire. Two kinds occur, the most common is entirely black and the other is black with a rusty red midsection. The adults vary in length from ¼ to ½" for the workers and up to 3/4" for the queens. Only the reproductive forms (kings and queens) have wings which are shed before selecting a nesting area.

Winged carpenter ants are frequently confused with winged termites and can be easily separated by the following comparisons:



Ant

Termite

WINGS:	*Hind wing shorter than fore wing*	*Wings equal in length*
BODY:	*Narrow waist*	*No waist*
ANTENNA:	*Elbowed*	*Straight*

Carpenter ant nests are constructed in wood with smooth walled galleries that are clean and free of sawdust. Termites, on the other hand, have tunnels and galleries filled with large amounts of packed, moist, sawdust-like material, and are not smooth and clean.

LIFE HISTORY AND HABITS

A single winged female carpenter ant begins a colony by shedding her wings, and selecting a desirable nesting site, generally moist wood that has weathered and begun to decay. In buildings this may be in porch columns, steps, corners of buildings, under eaves, between

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walls, in door and window frames, beams, and joists. Outdoor nests are frequently found in wood piles, stumps, fence and telephone posts and rotten trees. Therefore, foraging ants found within a building may come from a nest established either within the building or out of doors.

Carpenter ant workers do not eat wood as do termites, but excavate galleries to rear their young. They feed upon other insects, honey dew from aphids, plant juices, sweets, and scraps of food.

During the winter the nests are inactive but occasionally individuals are seen on warm days. Winged males and females emerge in the spring and summer. A new colony will increase and survive for several years.

CONTROL

Locate the nest! This is essential in effectively controlling the carpenter ant. Places to look to locate a nest indoors would include moist wood such as porch floors and columns, eaves, and where wood comes in contact with soil. Piles of coarse sawdust on the floor or foundation is also a good sign. By watching the activities of worker ants you can often discover their avenues of entrance into the wood. It may be possible to actually hear them moving with a rustling noise between the walls. Sometimes you can feel an increase in temperature on the wall where the nest is located. In the outdoors inspect piles of wood, old stumps, and trees with rotted firewood. Branches hanging over and touching the roof of the house may be inviting outdoor ants to enter the building.

Preventive measures should be taken by eliminating stumps, storing firewood off the ground and covered, and preventing structural wood from becoming moist. This may require repairing roofs, gutters, and leaky pipes and providing ventilation in crawl spaces.

Chemical control is necessary once the nest has been located. Spraying or dusting the infested area without locating and treating the nest usually does not provide complete control. Treat holes, openings or cracks with 5% chlordane dust in a rubber bulb or plastic squeeze bottle (the type used to dispense catsup is ideal). It may be necessary to remove molding or baseboard or drill holes in the timber in order to get the dust into the hidden tunnels.

A 2% chlordane water spray can be applied to baseboards, molding, sills, behind appliances to kill foraging ants. By applying this spray to the outside foundation walls and around windows and doors, ants coming in from the outside can be prevented.

Alternative materials to chlordane are Baygon (.5% spray), diazinon (.5% spray or 1-2% dust), or malathion (3% spray or 4-5% dust). These materials, however, do not have the residual action of chlordane and may require several applications. *See label directions on how to dilute the liquid sprays.*

SAFE USE OF PESTICIDES

Stop!!! Read the label on every pesticide container each time before using the material. Pesticides must be applied only as directed. Avoid inhaling dusts or sprays. Open windows and ventilate the rooms while using pesticides. Never smoke or eat while spraying or dusting. Remove or cover food, feed, water, kitchen utensils and fish and other pets. Do not allow children near you when applying pesticides. Wash and clean up after using pesticides - change clothes if any pesticide was spilled. Dispose of empty containers safely. Bury 18" deep in an isolated area away from any water supply or place in a trash container. Do not burn aerosol cans. Store pesticides in their original containers in a locked cabinet or shed away from food. Be sure tops or caps are on tight. In case of an accident, follow label directions and call a physician immediately.

IMPORTANT CHARACTERISTICS

FOR RECOGNIZING SOME COMMON SPECIES OF ANT WORKERS

Species	Color	Approximate size	Pedicel	Antennae shape
Thief Ant, *Solenopsis molesta*	Reddish, yellowish, or pale brown	1/15 inch	Double	Ending in 2 clubbed segments
Pavement Ant, *Tetramorium caespitum*	Dark brown	1/10 inch	Double	Ending in 3 clubbed segments
Acrobat Ant, *Crematogaster lineolata*	Medium to dark brown	1/8 inch	Double	Scape projecting beyond head
Pharoah's Ant, *Monomorium pharaonis*	Reddish, yellowish, or light brown	1/12 inch	Double	Each segment increasing in size
Little Black Ant, *M. minimum*	Shiny black	1/14 inch	Double	12 segments; 3 form club
Carpenter Ant, *Camponotus pennsylvanicus*	Black or reddish	1/4 to 1/2 inch	Single	12 segments; 3 form club
Larger Yellow Ant, *Acanthomyops interjectus*	Yellow or yellowish-brown	1/6 inch	Single	Scape projecting beyond head, no club
Smaller Yellow Ant, *A. claviger*	Yellow or yellowish-brown	1/7 inch	Single	Scape projecting beyond head, no club
Cornfield Ant, *Lasius alienus*	Light to dark brown	1/11 inch	Single	No club

ANTS: KEY TO SOME COMMON SPECIES

Harold George Scott

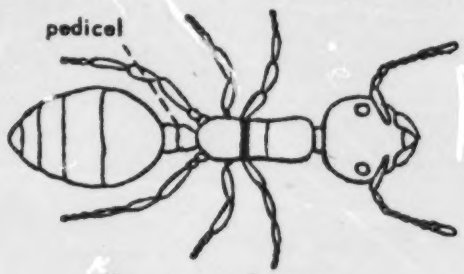
1. Pedicel ("waist") 1-segmented 2
   Pedicel 2-segmented 4

2. Petiole (scale on pedicel) poorly developed, hidden beneath abdomen (*Tapinoma sessile*) ..... ODOROUS HOUSE ANT
   Petiole well-developed, erect, not hidden beneath abdomen 3

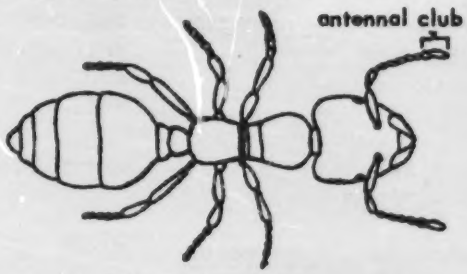
3. Tip of abdomen without circlet of hairs (*Iridomyrmex humilis*) ..... ARGENTINE ANT
   Tip of abdomen with circlet of hairs (*Camponotus herculeanus pennsylvanicus*) ..... BLACK CARPENTER ANT

4. Head and thorax with numerous spines (*Atta texana*) ..... TEXAS LEAF-CUTTING ANT
   Head and thorax spineless or with 1 pair of spines on the posterior thorax 5

5. Thorax and head covered with "fingerprints"; posterior thorax with single pairs of spines (*Tetramorium caespitum*) ..... PAVEMENT ANT
   Thorax and head without "fingerprints"; posterior thorax without spines 6



Monomorium pharaonis



Solenopsis molesta

6. Antennal club 2-segmented 8
   Antennal club 3-segmented 7

7. Shiny-black (*Monomorium minimum*) ..... LITTLE BLACK ANT
   Yellowish-red (*Monomorium pharaonis*) ..... PHARAOH ANT

8. House infesting ants (*Solenopsis molesta*) ..... THIEF ANT
   Outdoor mound-building ants 9

9. Mandibles strongly incurved (*Solenopsis geminata*) ..... TROPICAL FIRE ANT
   Mandibles not strongly incurved 10

10. Dorsal surface of head with large coarse, scattered punctures (*Solenopsis saevissima* var. *richteri*) ..... IMPORTED FIRE ANT
    Dorsal surface of head without punctures (*Solenopsis xyloni*) ..... SOUTHERN FIRE ANT

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1963

STINGING HYMENOPTERA:
PICTORIAL KEY TO SOME COMMON UNITED STATES FAMILIES

Harold George Scott and Chester J. Stojanovich

wings absent

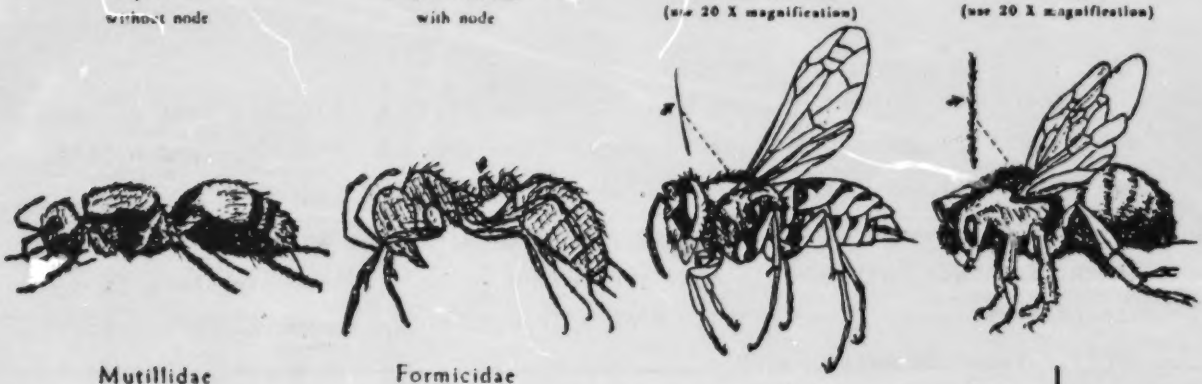
wings present

body fur-like without node

body not fur-like with node

hairs not feathered (use 20 X magnification)

hairs feathered (use 20 X magnification)



Mutillidae
VELVET ANTS

Formicidae
ANTS

pronotum long, reaching tegula

pronotum short, not reaching tegula

Vespidae
WASPS, YELLOW JACKETS, HORNETS

Sphecidae
SPHECID WASPS

hind tibia with spurs

hind tibia without spurs

eye not reaching mandible

eye reaching mandible

Bombidae
BUMBLE BEES

Andrenidae
SWEAT BEES

Apidae
HONEY BEES

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia -- 1962

COCKROACHES

There are several species of cockroaches in U. S. but only four of them are found throughout the United States. They vary in appearance and habits, but in general, are all flat, brownish or dark colored, and fast running. All roaches seek cover in the daytime or when disturbed at night. They may be carried into buildings in boxes, beverage cases, and shopping bags from the grocery store. They migrate from apartment to apartment along water pipes, cracks in walls, wall voids, steam pipes and sewer lines. They feed on starchy materials such as cereals. sugary substances, dried fruits, and meat products. Roaches frequent cheese, beer, leather, hair, wallpaper, and dead animals.

Cockroaches have three stages of development: Egg, nymph, and adult. Eggs are deposited within an egg capsule called an ootheca. This ootheca contains up to 16 eggs. From this egg capsule hatch small white nymphs which will darken to a brown color as the exoskeleton begins to dry and harden. The nymphs molt four times before becoming adults. Depending upon the species involved, development from egg to adult takes from 6 to 7 months.

According to Arnold Mallis:

> *"Cockroaches have often been held suspect as disease carriers, and they are believed to be as suitable for the conveyance of common germs as is the house fly."*

These diseases and organisms include cholera vibrios, coliform bacilli, Gastro-enteritis, and Salmonella.

AMERICAN COCKROACH - Periplaneta americana (L.)

This is the largest of the usual house-infesting roaches. When fully grown they are approximately 1½" in length with fully developed wings. The wings are reddish brown in color with light markings on the thorax.

The American roach is commonly found in basements of homes around the heating pipes and sewage systems, in restaurants, grocery stores, bakeries and food preparation areas.

GERMAN COCKROACH - Blattella germanica (L.)

This roach is smaller than the American roach. When fully grown it is about ½" in length. Both male and female are brown in color and have two dark streaks on the thorax. The male is a lighter brown color than the female. The female produces 30 to 40 eggs per egg capsule.

The German cockroach is the most common roach found in New Hampshire. It is found in restaurants, grocery stores, food preparation areas and in homes.

BROWN-BANDED COCKROACH - Supella supellectilium (Serville)

The name brown-banded refers mainly to the immature stage of this roach. Even though the band is present in both adult and immature stages, it is more distinct in the nymphal stage.

This cockroach favors kitchens (cupboards, pantries) but can be found in any room of the house. The adult is an active flier which accounts for its ability to spread easily.

ORIENTAL COCKROACH - Blatta orientalis (L.)

As an adult, the Oriental cockroach attains a length of one inch. It is shiny black in color. Wings of this species are very small in females and only cover 3/4 of the abdomen in males. This roach favors damp areas in basements and often enters homes through sewer openings. During the warm summer months, this roach may live outdoors and re-enter into the home as cooler weather returns in the fall.

COCKROACHES: PICTORIAL KEY TO SOME COMMON SPECIES

Harry D. Pratt

SMALL, ABOUT 5/8" OR SHORTER

PRONOTUM WITH 2 LONGITUDINAL BLACK BARS

GERMAN COCKROACH
(Blattella germanica)

PRONOTUM WITHOUT LONGITUDINAL BLACK BARS

WINGS COVERING ABOUT HALF OF ABDOMEN PRONOTUM ABOUT 1/4 INCH WIDE

WOOD ROACH
(Parcoblatta spp.)

WINGS COVERING NEARLY ALL OF ABDOMEN OR EXTENDING BEYOND. PRONOTUM NARROWER

BROWN-BANDED COCKROACH
(Supella supellectilium)

MEDIUM TO LARGE, LONGER THAN 5/8 INCH

WINGS ABSENT, OR SHORTER THAN ABDOMEN

WINGS ABSENT

WINGS SHORTER THAN ABDOMEN

ORIENTAL COCKROACH
(Blatta orientalis)

WINGS COVERING ABDOMEN, OFTEN EXTENDING BEYOND

PRONOTUM MORE THAN 1/8 INCH WIDE

PRONOTUM ABOUT 1/4 INCH WIDE WITH PALE BORDER

WOOD ROACH
(Parcoblatta spp.)

FRONT WING WITHOUT PALE STREAK. PRONOTUM SOLID COLOR, OR WITH PALE DESIGN ONLY MODERATELY CONSPICUOUS

PRONOTUM SOLID DARK COLOR. GENERAL COLOR VERY DARK BROWN TO BLACK

SMOKY BROWN COCKROACH
(Periplaneta fuliginosa)

PRONOTUM USUALLY WITH SOME PALE AREA. GENERAL COLOR SELDOM DARKER THAN REDDISH CHESTNUT

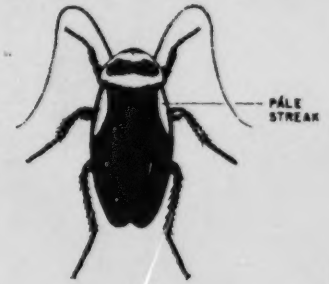
LAST SEGMENT OF CERCUS NOT TWICE AS LONG AS WIDE

BROWN COCKROACH
(Periplaneta brunnea)

LAST SEGMENT OF CERCUS TWICE AS LONG AS WIDE

AMERICAN COCKROACH
(Periplaneta americana)

FRONT WING WITH OUTER PALE STREAK AT BASE PRONOTUM STRIKINGLY MARKED



AUSTRALIAN COCKROACH
(Periplaneta australasiae)

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Communicable Disease Center
Training Branch
Atlanta, Georgia – 1953

0 1/2 1
SCALE IN INCHES

COCKROACHES: COMPARISON OF BIOLOGICAL FACTORS

Biological Characteristic	German Cockroach	American Cockroach	Oriental Cockroach	Brown-banded Cockroach
Average number of eggs per capsule	36	16	16	18
Incubation period for eggs in days	28.4 (average)	38-49	42-81	50-70
Length of time the female carries egg capsule	Entire incubation period except for last few hours	About a day after it is formed	About 30 hours	24 to 26 hours
Average number of young that emerge from an egg capsule	29.9	13.3	14.4	13.2
Where egg capsules are deposited	In cockroaches' hiding place	In cracks and crevices	Warm, sheltered spots	Attached to objects
Average number of generations per year	3	1 at most	1 at most	1 to 2
Flying ability	Does not fly	Males fly; females glide	Does not fly	Active flier
Where found	Homes, restaurants, ships	Homes, cellars, ships, restaurants	Sewer pipes, sidewalks, heat tunnels, damp cellars, buildings, bathrooms, laundries	Closets, kitchens, furniture, behind pictures

COCKROACHES: KEY TO EGG CASES
OF COMMON DOMESTIC SPECIES

less than ½" long
subsegments apparent

more than ½" long
subsegments inapparent

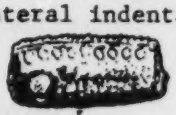
with about 16
subsegments; length
more than twice width

Blatella germanica
GERMAN COCKROACH

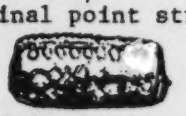
with about 8
subsegments; length
less than twice width

Supella supellectilium
BROWN-BANED COCKROACH

With lateral indentations

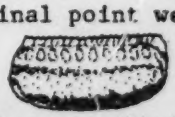


terminal point strong



Periplaneta brunnea
BROWN COCKROACH

terminal point weak



Periplaneta fuliginosa
SMOKY-BROWN COCKROACH

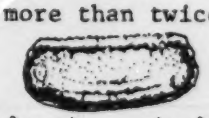
without lateral indentations

not symmetrical

Blatta orientalis
ORIENTAL COCKROACH

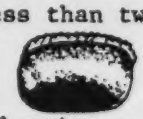
symmetrical

length more than twice width



Periplaneta australasiae
AUSTRALIAN COCKROACH

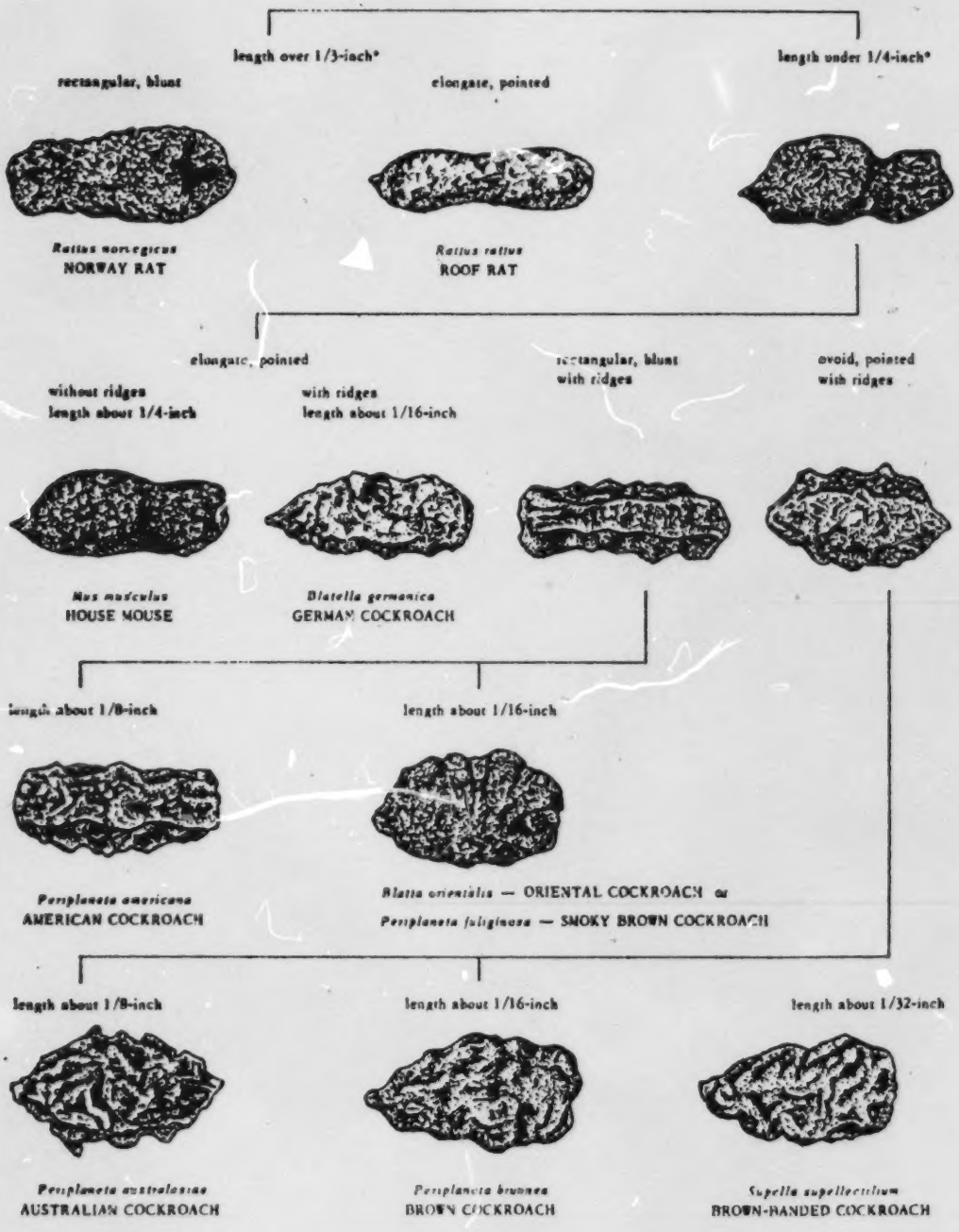
length less than twice width



Periplaneta americana
AMERICAN COCKROACH

DOMESTIC RODENTS AND COCKROACHES: PICTORIAL KEY TO DdroppINGS

Harold George Scott and Margery R. Borom



*All characteristics for average, dry, adult droppings. Study groups, not individual droppings.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1964

COOPERATIVE EXTENSION SERVICE

University of New Hampshire

Department of Entomology cooperating

BUG FACTS

SPRINGTAILS OR "SNOWFLEAS"

J. S. BOWMAN
Extension Entomologist

A common occurrance each winter and early spring in the State of New Hampshire is the appearance of large numbers of minute jumping insects called springtails or "snow fleas." They are most often seen during warm periods when a thaw is in progress. They occur in large masses or piles near snow or at the edge of snow pools or slow-moving streams. Their members can be in the millions. When disturbed they can be observed jumping a short distance with the aid of a forked appendage attached to the end and underside of the abdomen that can be sprung in a downward movement and catapult the insect into the air (see above drawing). The most commonly occurring species in New Hampshire are either rust-red or dark gray to black in color.

Springtails belong to a group of primitive insects known as Collembola. They feed mainly on decaying organic matter, such as rotting leaves and wood, dead worms, insects and other animals, as well as algae, fungi and lichens. They are primarily an outdoor pests, but occasionally are found invading buildings where they can become a nuisance. Since they require moisture to survive, they are found in damp places such as under porches, near foundations, in window boxes, flower pots, in basements or near plumbing leaks. Although they do not cause structural or material damage, they can become so numerous that they will cover walls and drapery once inside a building.

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CONTROL

Prevention of sources of moisture, especially moist soil, is the best way to prevent an invasion inside a building. By preventing plumbing leaks and directing downspouts away from buildings to prevent wet spots next to the foundation, the problem can be avoided. Confined areas, such as under porches, should be well ventilated.

Outdoor populations are usually more of a curiosity than a problem. The sudden large numbers of springtails that occur in the spring will disappear within a week or as soon as the soil begins to dry out. However, when they occur near a building that could become invaded, it may be necessary to reduce their numbers through the use of insecticides. Homeowner products such as malathion, methoxychlor, pyrethrins and chlordane are effective in controlling springtails. Applications should be made in accordance with the directions on the pesticide label.

SAFE USE OF PESTICIDES

Stop!!! Read the label on every pesticide container each time before using the material. Pesticides must be applied only as directed. Avoid inhaling dusts or sprays. Open windows and ventilate the rooms while using pesticides. Never smoke or eat while spraying or dusting. Remove or cover food, feed, water, kitchen utensils and fish and other pets. Do not allow children near you when applying pesticides. Wash and clean up after using pesticides - change clothes if any pesticide was spilled. Dispose of empty containers safely. Bury 18" deep in an isolated area away from any water supply or place in a trash container. Do not burn aerosol cans. Store pesticides in their original containers in a locked cabinet or shed away from food. Be sure tops or caps are on tight. In case of an accident, follow label directions and call a physician immediately.

2M/75

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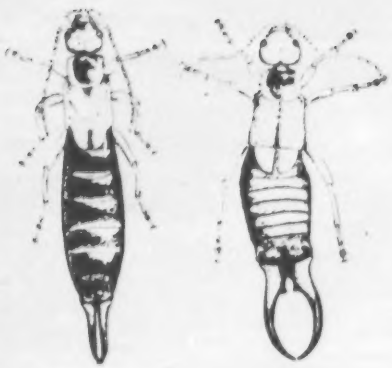
BUG FACTS



Female Male

EARWIGS

J. S. BOWMAN
Extension Entomologist

The European Earwig is a common pest of the home and garden in New England. It is not only repulsive in appearance, but can also be quite destructive to home and garden plants. Earwigs have a foul odor and invariably show up in unwanted places, such as around the kitchen or bathroom.

APPEARANCE AND BEHAVIOR

The adult European earwig is reddish brown and resembles certain beetles. Unlike other insects, it has a pair of forceps-like appendages on the end of the body. They can be used to determine the sex of the individuals (see drawing). The forceps are used by earwigs as a defense organ and also aid in mating. The wings of earwigs are very short, exposing the abdomen, and are seldom used for flying. The antennae are slender and very flexible. Young earwigs resemble the adult female but are smaller and lighter in color.

In New England, earwigs overwinter in the adult stage. In early spring the female lays eggs in a nest in the ground and will carefully guard the eggs until they hatch. She will then brood her young until they are capable of caring for themselves. There are usually about 30 young in a brood.

During the day the earwig is inactive and hides in a variety of places in and around the house, such as in wet mops, flower pots, woodpiles, behind loose boards, at the base of trees and in shrubbery. They become active at night and roam about feeding on a variety of things (i.e. garbage and various house plants). In the garden they are known to damage dahlias, zinnias, butterfly bush, lettuce, strawberry, celery, potatoes and seedling beans and beets. You can also find them in the ears of corn where they feed on the silks.

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CONTROL

Since earwigs are chiefly an "outdoor insect", elimination of their outdoor habitats, such as leaves and debris next to the house, will help discourage their presence. However, chemical control may be needed to eliminate a population that has built up. The following sprays and dusts are suggested:

OUTDOORS

Chlordane	5 - 10% dust (ready-to-use)
	2% spray
Carbaryl	0.5% spray
Diazinon	0.5% spray

Apply to areas around the foundation of the house where earwigs are seen. Treat entire infested area except where indicated in the precautions stated on the label. Apply in the spring as the young earwigs are leaving their nests and again in midsummer if earwigs are troublesome.

INDOORS

Baygon	0.5% - 1% aerosol (ready-to-use)

Follow the label instructions.

SAFE USE OF PESTICIDES

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4/75/5M

COOPERATIVE EXTENSION SERVICE

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BUG FACTS

KITCHEN PESTS

J. S. BOWMAN

Extension Entomologist

The kitchens in our homes contain an array of stored food items that serve as welcomed habitats for many insect pests, commonly referred to as "pantry" pests. These include a variety of beetles and moths that are capable of infesting and destroying such dried foods as cereals, flour, corn meal, cornstarch, crackers, cookies, dried pet foods, bird seed, macaroni, spaghetti, bread crumbs, dried fruits, dried meats, dried soup mixes, cake mixes, powdered milk, candy, chocolate, and spices such as red pepper, paprika, and chili powder. Since many of these items are only used occasionally, they spend much time setting on the shelves inviting a would-be invader to take up permanent residence.

Such pests are usually brought into the home accidentally in infested products from the food market or surplus food depots from which they spread to other products on the shelf. However, infestations are usually not discovered until the housewife begins to observe small beetles or worms crawling across her counter top, webs in the oatmeal, the cast skins of larvae under the sink or in the cupboards or occasional moths flying around the kitchen. By this time the invaders could be well-established and can cause considerable damage if not eliminated.

THE PESTS

A variety of different kinds of insects is known to infest our stored foods, but the most common in New Hampshire are the saw-toothed grain beetle, confused flour beetle, dermestid beetles and Indian meal moth. A description of each of these pests is given below. Other less common pests include the larder beetle, Mediterranean meal moth, foreign grain beetle, rice weevils, cigarette and drug store beetles, and spider beetles. They all feed on generally the same type of foods and the control measures are similar for all of them.

SAW-TOOTHED GRAIN BEETLE

The saw-toothed grain beetle, our most common kitchen pest, is a slender, flat, brown beetle about one-tenth of an inch long. It gets its name from the 6 saw-tooth-like projections on either side of the thorax (mid-section). Both the larvae and adults feed on a variety of dried foods. The adults live an average of 6-10 months but can live as long as 3 years. Eggs are laid in the food and hatch in 3-5 days. The resulting larvae mature in about 2 weeks, then pupate and emerge as adults in about 1 week. The life cycle from egg to adult is about 3-4 months.

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CONFUSED FLOUR BEETLE

The confused flour beetle is a reddish-brown beetle about one-seventh of an inch long with minute punctures on the head and thorax and ridges on the hind wings. The life cycle is similar to the saw-toothed grain beetle except the average beetle lives about 1 year and the life cycle takes about 6 months.

CARPET BEETLES

Dermestid beetles, as a group, are best known as scavengers that feed on animal matter such as hides and wool products. Several species, including the black carpet beetle, feed on foodstuff and are a common kitchen pest. The larvae are very destructive and are readily recognized by the tuft of long hairs protruding from the end of the body. They are usually golden brown and the entire body covered with scale-like hairs. The adults will vary in size and color depending on the species.

INDIAN MEAL MOTH

The Indian meal moth is the most common moth species in New Hampshire kitchens. The adult moth has a wing span of about 3/4 inch and the forewings are banded whitish gray and copper in color. Eggs are laid on the foodstuff and hatch into small whitish larvae within a few days. The larvae feed on the food and spin webs as they crawl around. This webbing is often the first evidence of an infestation. The life cycle is completed in 6 to 8 weeks.

CONTROL OF KITCHEN PESTS

Good sanitation is important in preventing the spread of an infestation. Spilled food that gets into cracks, under sinks, under the refrigerator and dishwasher, and behind drawers will harbor insects and keep an infestation going. Periodic cleaning and vacuuming debris will help discourage an infestation from spreading should you accidently bring them into your home.

If the problem is discovered early, before food becomes badly infested, measures can be taken to salvage the food through heat sterilization or cold treatment. Spread the contents out on a tray and heat in an oven at 130° F. for 30 minutes, or place in a deep freeze at 0° F. for 4 days. Repackage in tightly closed containers such as glass jars or cans. Badly infested food should be destroyed or disposed of by sealing the containers and placing in the garbage.

Chemical control becomes necessary when the infestation has spread to several food items and has undoubtedly gotten into cracks and remote areas of the kitchen. Remove all food and kitchenware from the shelves and clean thoroughly using a vacuum. Treat cracks and corners by spraying lightly or using a paint brush with one of the following materials. DO NOT OVERSPRAY.

Malathion (premium grade)	-	3% spray
propoxur (Baygon)	-	1% spray
pyrethrins + piperonyl butoxide	-	.1% to .25% + 1% - 2% spray

Allow the spray to dry before recovering shelves with fresh paper or foil and replacing food packages, dishes and cookware.

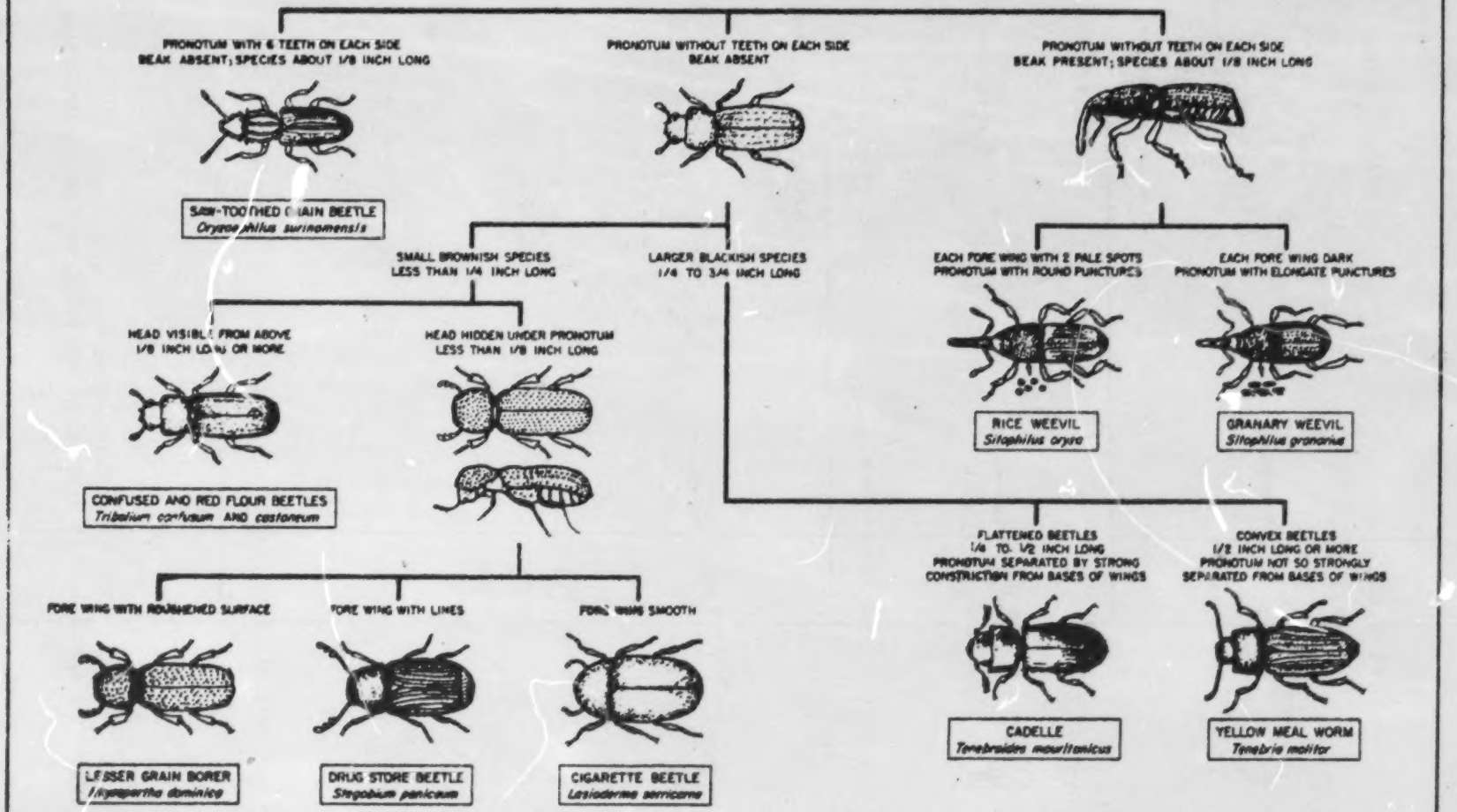
SAFE USE OF PESTICIDES

Stop!!! Read the label on every pesticide container each time before using the material. Pesticides must be applied only as directed. Avoid inhaling dusts or sprays. Open windows and ventilate the rooms while using pesticides. Never smoke or eat while spraying or dusting. Remove or cover food, feed, water, kitchen utensils and fish and other pets. Do not allow children near you when applying pesticides. Wash and clean up after using pesticides - change clothes if any pesticide was spilled. Dispose of empty containers safely. Bury 18" deep in an isolated area away from any water supply or place in a trash container. Do not burn aerosol cans. Store pesticides in their original containers in a locked cabinet or shed away from food. Be sure tops or caps are on tight. In case of an accident, follow label directions and call a physician immediately.

12/74/5M

BEETLES: PICTORIAL KEY TO SOME SPECIES COMMONLY ASSOCIATED WITH STORED FOODS

Harry D. Pratt



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1958

HOUSEHOLD AND STORED-FOOD PESTS: PICTORIAL KEY TO COMMON LARVAE

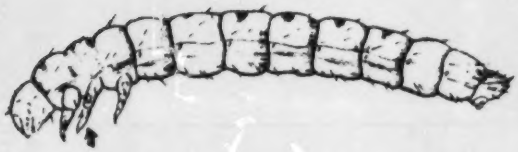
Chester J. Stojanovich & Harold George Scott

abdominal legs present

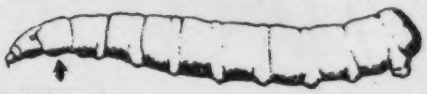
abdominal legs absent

MOTH LARVAE

thoracic legs present

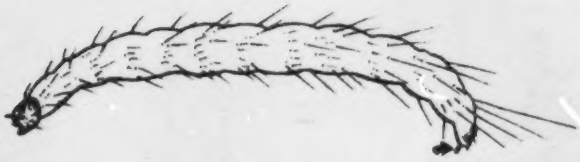


thoracic legs absent

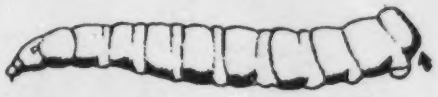


BEETLE, BORER & MEALWORM LARVAE

with fleshy lobes at ends of body

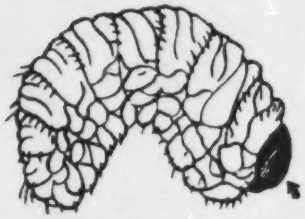


without fleshy lobes at ends of body

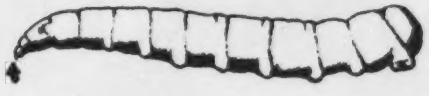


FLEA LARVAE

head capsule present



head capsule absent



WEEVIL LARVAE

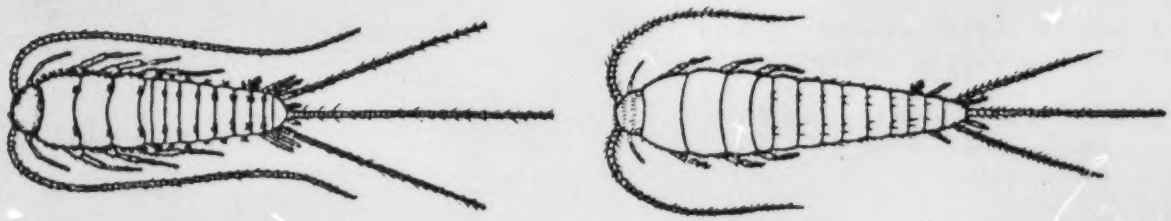
MUSCOID FLY LARVAE

SILVERFISH. PICTORIAL KEY TO DOMESTIC SPECIES

Chester J. Stojanovich and Harold George Scott

setae in tufts
color brown

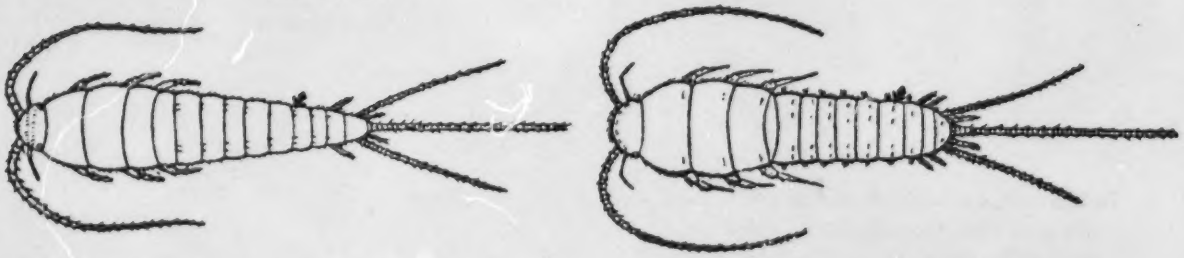
setae single



Thermobia domestica
FIREBRAT

without setal combs
color silver

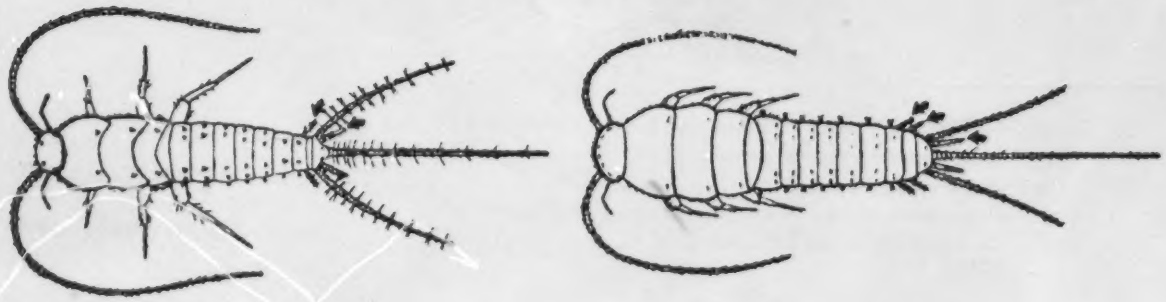
with setal combs



Lepisma saccharina
COMMON SILVERFISH

2 pairs of styli
color gray

3 pairs of styli
color brown



Ctenolepisma urbana
GIANT SILVERFISH
Ctenolepisma longicauda of some authors

Ctenolepisma quadriseriata
FOUR-LINED SILVERFISH

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1962

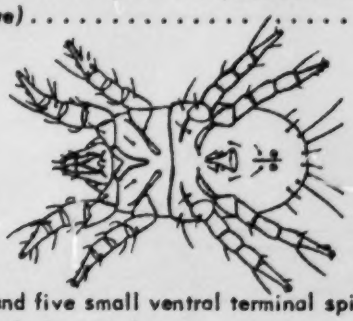
MITES: KEY TO SOME SPECIES COMMONLY INFESTING HOUSEHOLDS AND STORED FOOD

Harold George Scott

1. With club-like hair between bases of legs I and II 5
   Without club-like hair between bases of legs I and II 2

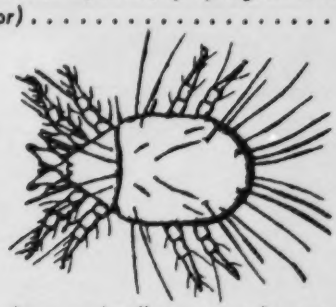
2. Claws, if present, not on stalks (*Glycyphagus domesticus*, formerly *Glyciphagus prunorum*) ..... SUGAR MITE
   Claws on stalks 3

3. Internal apical hair (on joint between femur I and tibia I) less than three times as long as external apical hair 4
   Internal apical hair (on joint between femur I and tibia I) more than three times as long as external apical hair (*Acarus farinae*, formerly *Tyroglyphus farinae*) ..... HAM MITE



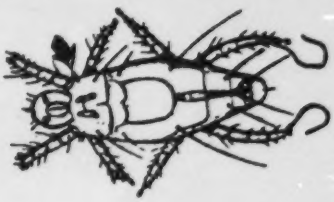
Acarus farinae

4. Tarsus with one stout dorsal and five small ventral terminal spines (*Acarus siro*, formerly *Tyroglyphus siro*) ..... GRAIN MITE
   Tarsus with only three small ventral spines (*Tyrophagus castellani*, formerly *Tyroglyphus longior*) ..... CHEESE MITE



Tyrophagus castellani

5. Tarsus IV of female ending in claws and a fleshy protuberance; leg IV of male smoothly curved inwards (*Pyemotes ventricosus*, formerly *Pediculoides ventricosus*) ..... STRAW ITCH MITE
   Tarsus IV of female ending in two long hairs of unequal length; leg IV of male sharply bent (*Tarsonemus floricolus*) ..... FLORICOLUS GRAIN MITE



Pyemotes ventricosus

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1963

ORGANISMS OF PUBLIC HEALTH SIGNIFICANCE

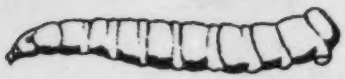
COMMON NAME	PUBLIC HEALTH SIGNIFICANCE
Ant	bite, sting; infest stored food; damage wood
Bat	associated with rabies, histoplasmosis and many other diseases
Bed Bug	cause dermatitis; not known to transmit disease
Bee, Hornet, etc.	bite and sting; infest stored food; damage wood
Beetle	infest stored food; infest human intestine; cause dermatitis
Bird	associated with histoplasmosis, ornithosis and many other diseases
Book Louse, Psocid	infest stored food
Caterpillar	sting; infest intestinal tract
Centipede	venomous bite; infest nasal, intestinal, and urinary tracts
Chewing Louse	infest domestic birds and mammals
Cockroach	transmit enteric diseases
Collembola	infest stored food; used as indicator organisms for pesticide studies
Copepod	involved in transmission of broad fish tapeworm and guinea worm
Daddylongleg Spider	infest houses; harmless
Earwig	household pests
Flea	cause dermatitis; transmit plague, murine typhus, tapeworms
Fly	some bite; larvae infest human flesh; transmit typhoid, paratyphoid, cholera, bacillary dysentery, infantiel diarrhea, amebic dysentery, giardiasis, helminths, trachoma, conjunctivitis, yaws, anthrax, tularemia, African sleeping sickness, leishmaniasis, onchocerciasis, loiasis, bartonellosis, sandfly fever
Ked or Louse Fly	occasionally bite man
Kissing Bug	transmit Chagas disease
Lagomorph	transmit tularemia and many other diseases
Lobster, Crab, etc.	involved in transmission of oriental lung fluke
Millipede	exude vesicating venom; infest digestive and urinary tract; intermediate host of tapeworms
Mite	cause dermatitis; infest human intestine; transmit scrub typhus, rickettsialpox, epidemic hemorrhagic fever

COMMON NAME	PUBLIC HEALTH SIGNIFICANCE
Mosquito	transmit malaria, encephalitis, yellow fever, dengue, filariasis
Moth or Butterfly	infest stored food; infest human intestine; some have stinging hairs
Pseudoscorpion	infest houses; harmless
Rodent	transmit leptospirosis, lymphocytic choriomeningitis, etc.
Scorpion	sting
Sea Spider	appearance causes fear; harmless
Silverfish, Firebrat	infest stored food; transmit enteric diseases
Snake	venomous bite; secondary infection of bites
Sowbug, Pillbug	household pests; harmless
Spider	venomous bite
Sucking Louse	cause dermatitis; transmit epidemic typhus, trench fever, relapsing fever
Sun Spider	non-venomous bite
Termite	destroy wood; housing deterioration
Thrips	bite man occasionally
Tick	cause dermatitis, tick paralysis; transmit spotted fever, relapsing fever, tularemia, Colorado tick fever, Russian spring-summer encephalitis
Whip Scorpion	appearance causes fear; harmless

HUMAN ECTOPARASITES: KEY TO COMMON GROUPS

Chester J. Stojanovich and Harold George Scott

legs absent — legs present



FLY LARVA
Order Diptera

legs present: head definite, 3 pairs of legs

legs present: head indefinite, 4 pairs of legs

flattened laterally — flattened dorsoventrally

beak jointed

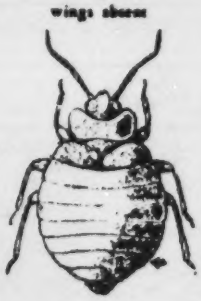
beak not jointed

FLEA
Order Siphonaptera

wings present

KISSING BUG
Order Hemiptera

wings absent



BED BUG
Order Hemiptera

mouthparts projected

LOUSE-FLY
Order Diptera

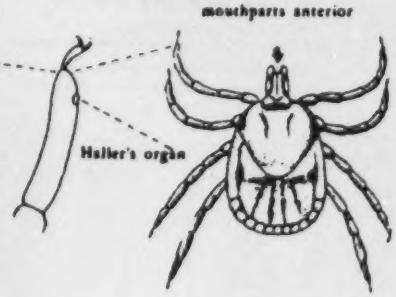
mouthparts retracted

LOUSE
Order Anoplura

over 4 mm. long; Haller's organ present

mouthparts ventral

mouthparts anterior



Haller's organ

SOFT TICK
Order Acarina

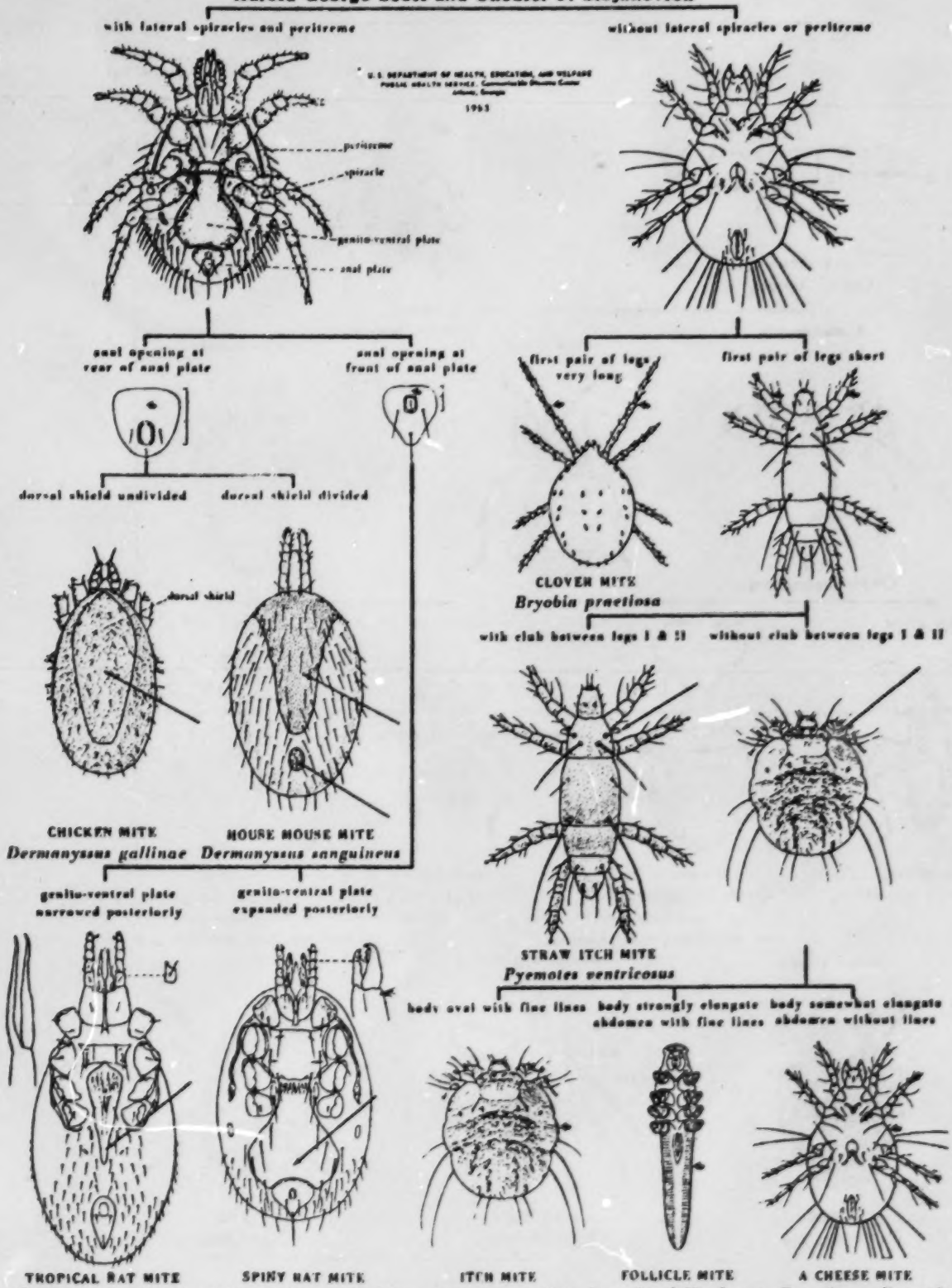
HARD TICK
Order Acarina

under 4mm. long; Haller's organ absent

MITE
Order Acarina

MITES: PICTORIAL KEY TO SOME COMMON SPECIES OF PUBLIC HEALTH IMPORTANCE

Harold George Scott and Chester J. Stojanovich



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1963

COOPERATIVE EXTENSION SERVICE
University of New Hampshire
Department of Entomology and
New Hampshire Department of Agriculture cooperating

BUG FACTS

HUMAN LICE

Dr. Robert L. Blickle
Professor of Entomology

Arthur H. Mason
State Entomologist

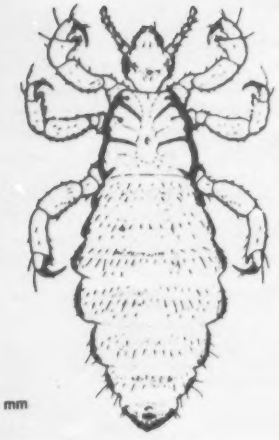


Figure 1
***Pediculus humanus capitis* head louse**

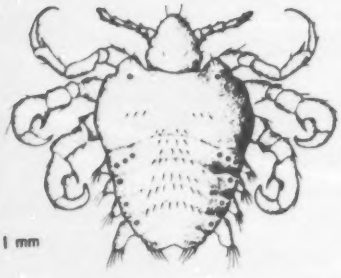


Figure 2
***Pthirus pubis* crab louse**

Entomologists classify lice as to (1) the order Mallophaga, chewing lice or, as the name suggests, wool-eaters. These live on birds and mammals except man and pigs. They feed primarily on feathers, skin products and hair and do not suck blood. Even though domestic animals have them, they do not infest humans; (2) the order Anoplura, sucking lice, is so named because they are flattened dorso-ventrally and have no apparent or noticeable pleura or sides to the body.

The Anoplura, sucking lice, live on mammals; marine, domestic and primates. Even though the two orders superficially resemble each other, they are radically different in feeding habits. The sucking lice feed on blood and have protrusible mouthparts. They are also less active than chewing lice and their legs are adapted to cling to hairs. In general, these lice have pointed heads (triangular in shape) while the chewing lice have broad, more rectangular or semi-circular-shaped heads.

Three Lice Infest Humans

Only three of the more than 200 known sucking lice infest humans. These three species are commonly known as the body louse, the head louse and the pubic louse.

The first two are very closely related and, although they may be identified by differences in body structure, it is easier to identify the species by their nits (eggs) and the place they are found on the human body.

Lice have been known for centuries. Human lice were found on embalmed mummies in Peru.

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The life cycle of human lice varies as to the species concerned. The ***Human Body Louse*** or cooties, as the name implies, feeds on the body. It lives in the clothing and lays its eggs on the seams and fibers of clothing, especially the underclothing. It lives in clothing where it is in close contact with the body and visits the body to feed. Although there are exceptions, if a body louse decides to move around it may be found at various places on the body although normally near areas where the clothing is tight.

This is the louse that has been implicated in the spread of disease throughout the world, not in New Hampshire. It is the louse that is a pest during wartime or when people are crowded together and clothing may not be changed too frequently. A condition called "Vagabond's disease" is due to heavy and prolonged infestations of lice. The skin becomes pigmented and thickened. The number of lice on a person may be a dozen or so, although heavier infestations have been recorded. This louse, although found in New Hampshire is not considered to be present in large numbers.

These lice may spread quite easily in crowded and unsanitary conditions during close personal contact. They may also be spread in sanitary and uncrowded conditions by close personal contact or contact with infested clothing. Usually, if one changes clothes frequently, those lice in the unworn clothing die of starvation or are destroyed by washing and cleaning.

The Head Louse: Although head lice are not considered as disease vectors, they are pests and undesirable. They occur on the head and the nits or eggs are cemented to the hairs, usually behind the ears. These lice may also be found in the headgear or possibly on other parts of the body.

An infestation of head lice is usually based on the finding of nits on the hairs. This may be difficult unless done by one familiar with the nits and the object is examined under a microscope. Hair casts, skin from the hair follicle, may be confused with nits unless examined carefully. Empty nits are not easily removed from a hair and there have been rare instances where wigs made of sterilized hair have been found to have louse eggs attached.

These insects spend their entire life cycle on the head so one would find adults, immatures and nits on the head or in the hair. They may be spread by the use of personal items such as hats, brushes and combs; also one can become infested from the backs of upholstered furniture or bedding if used after lice have wandered from an infested head to these objects. An infestation might be acquired by anyone.

These lice, like all human lice, cannot live away from the body for a period longer than 48 to 72 hours. They acquire warmth and a food source, otherwise they die of starvation or as a result of low temperatures.

The Pubic Louse: This insect is not a disease vector. It causes intense itching and secondary infections may result from scratching. Here the nits are attached to hairs and the entire life cycle is spent on the host. This insect usually dies in about 24 hours when separated from its host. Although close sexual contact is the usual means of spread, it has been recorded as being transmitted from infested bedding and other infested articles. They can be spread from person to person under crowded living conditions.

Treatment: Head and pubic (crab) lice infest the hair. The pubic louse usually is found in coarse hair on the body. To eliminate these lice and their nits, it is necessary to treat infested areas. Many preparations are available for the control of lice.

Those containing hydrocarbons, such as DDT or Lindane, are available only by prescription. Others containing pyrethrins, copper oleate or thiocyanates may be purchased without a prescription (follow the label directions).

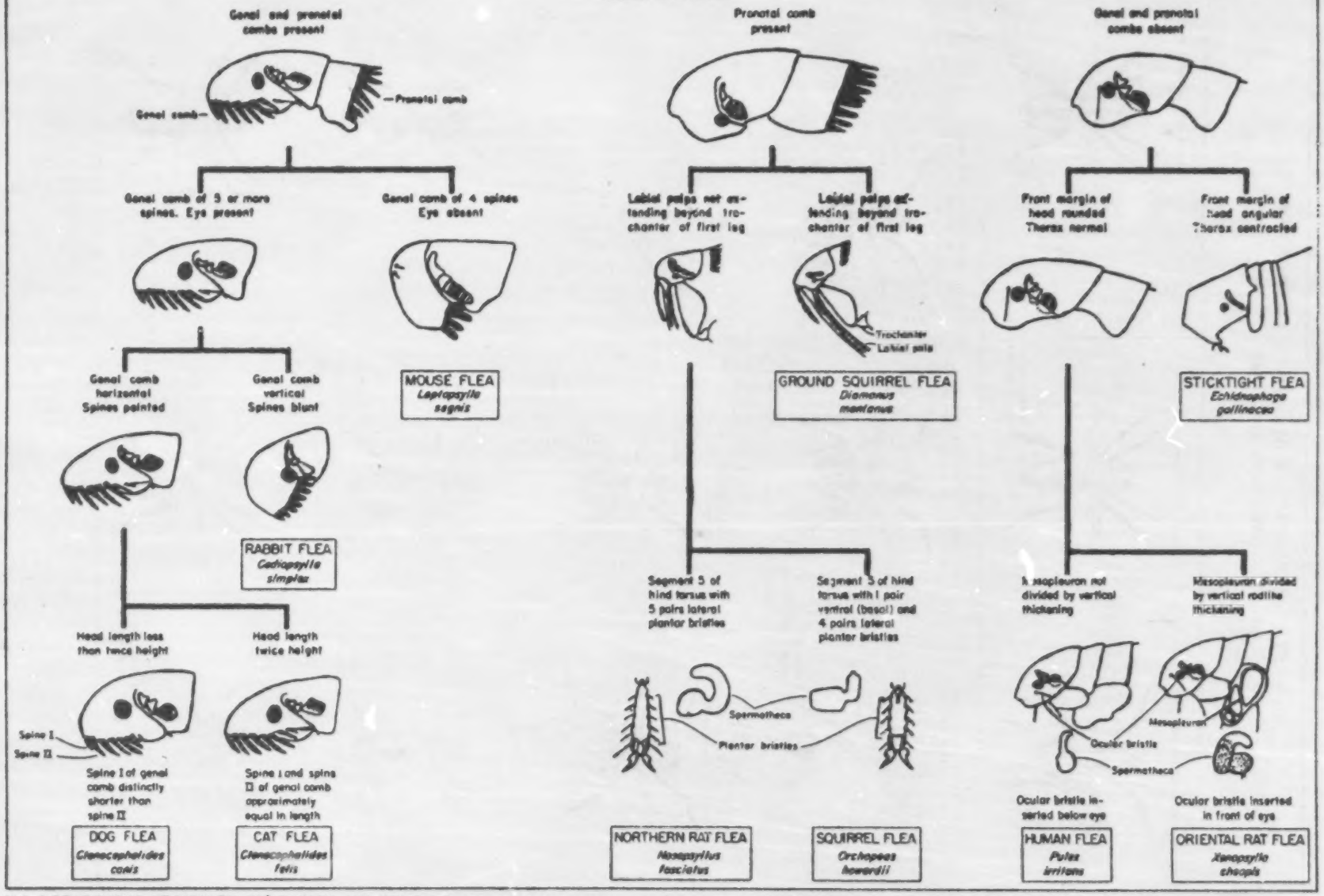
Washing the hair is not an adequate treatment in eliminating lice since the temperature of the water is not sufficient to kill all the stages. Body lice that infest clothing require a minimum temperature of 51°C. (123.8°F.) for five minutes to kill the adults and 52°C. (125.0 F.) for 10 minutes to kill the nits. Ordinary laundering in hot water or dry cleaning is usually enough to control or eliminate lice or nits on clothing.

Louse powders are recommended by the U.S. Public Health Service and W H O (World Health Organization). They may not be available and, in some cases, a dusting of the hair or clothes may not be accepable since the powder preparation should remain on the body or clothes for several days to be effective. One may prefer shampoos or lotions.

Do not over-react and apply excessive amounts of chemicals. Be certain to follow the directions on the label.

FLEAS: PICTORIAL KEY TO SOME COMMON SPECIES IN THE UNITED STATES

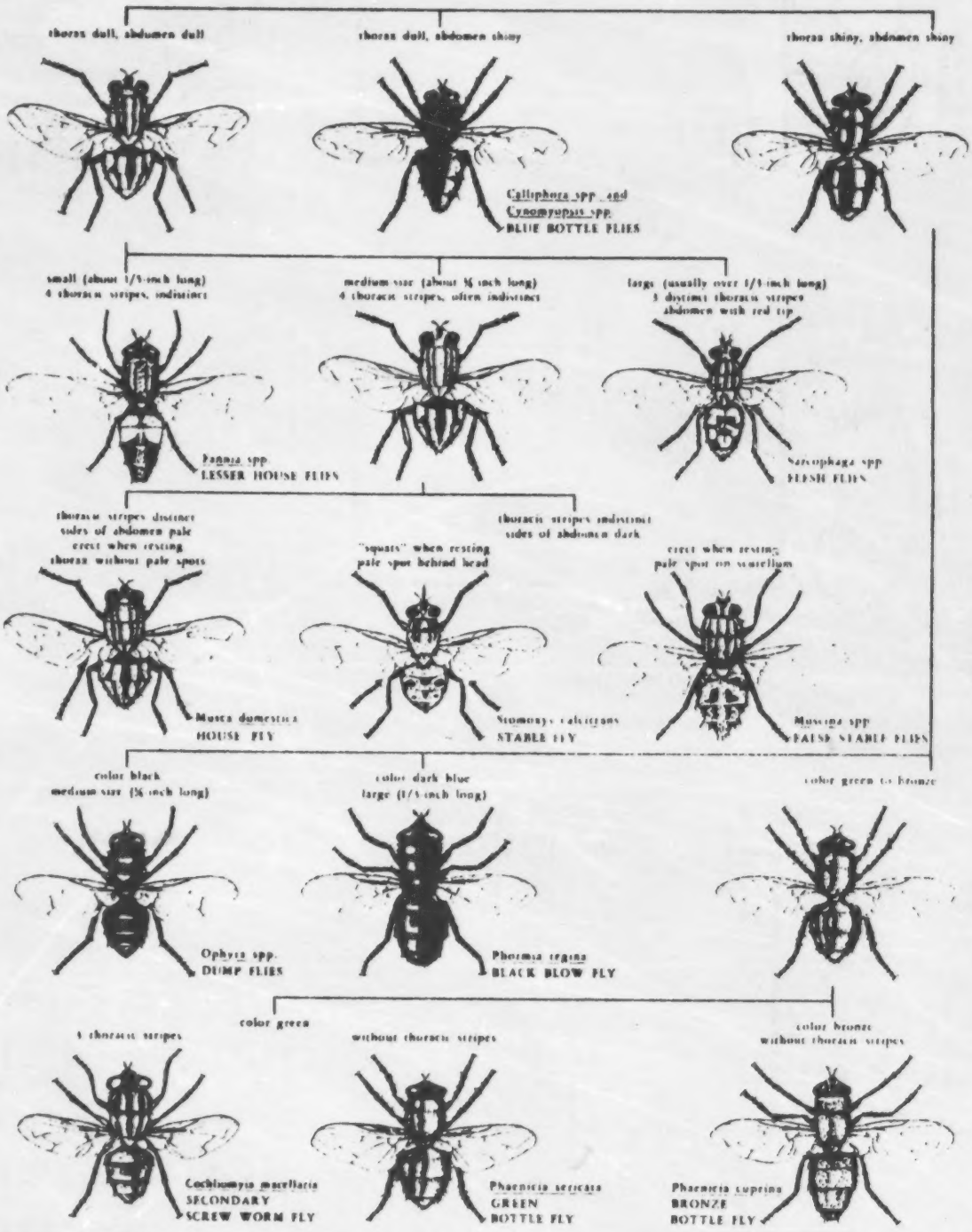
Harry D. Pratt


Genal and pronotal combs present
Genal comb
Pronotal comb
Genal comb of 5 or more spines. Eye present
Genal comb of 4 spines Eye absent
Genal comb horizontal Spines pointed
Genal comb vertical Spines blunt
MOUSE FLEA Leptopsylla segnis
RABBIT FLEA Cediopsylla simplex
Head length less than twice height
Head length twice height
Spine I
Spine II
Spine I of genal comb distinctly shorter than spine II
Spine I and spine II of genal comb approximately equal in length
DOG FLEA Ctenocephalides canis
CAT FLEA Ctenocephalides felis
Pronotal comb present
Labial palps not extending beyond trochanter of first leg
Labial palps extending beyond trochanter of first leg
Trochanter
Labial palp
GROUND SQUIRREL FLEA Diamanus montanus
Segment 5 of hind tarsus with 5 pairs lateral plantar bristles
Segment 5 of hind tarsus with 1 pair ventral (basal) and 4 pairs lateral plantar bristles
Spermatheca
Plantar bristles
NORTHERN RAT FLEA Nosopsyllus fasciatus
SQUIRREL FLEA Orchopeas howardii
Genal and pronotal combs absent
Front margin of head rounded Thorax normal
Front margin of head angular Thorax contracted
STICKTIGHT FLEA Echidnophaga gallinacea
Mesopleuron not divided by vertical thickening
Mesopleuron divided by vertical ridge like thickening
Mesopleuron
Ocular bristle
Spermatheca
Ocular bristle inserted below eye
Ocular bristle inserted in front of eye
HUMAN FLEA Pulex irritans
ORIENTAL RAT FLEA Xenopsylla cheopis

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1956

DOMESTIC FLIES: PICTORIAL KEY TO COMMON SPECIES

Harold George Scott and Margery R. Borom



Cooperative Extension Service
University of New Hampshire

Wildlife
Information
Series 1

BATS

Prepared by H. Stevan Logsdon, Extension Wildlife Specialist and Craig R. Fox

Cooperative Extension Service, University of New Hampshire, in cooperation with the Institute of Natural and Environmental Resources, Pettee Hall, Durham, N.H. 03824, Tel. (603) 862-1000

The two most common bat species in New Hampshire are the Little Brown Bat *(Myotis lucifugus)* and the Big Brown Bat *(Eptesicus fuscus fuscus)*. Six other species have been recorded: Say's Bat, Indiana Bat, Silver-haired Bat, Pipistrel, Red Bat and Hoary Bat. The Hoary Bat and the Indiana Bat are rare.

Two distinct groups of bats are found throughout New England, the solitary or tree bats and the cave bats. The Big and Little Brown Bats are both classified as cave bats. Tree bats choose to roost singly or in small clusters in woodlands while cave bats tend to frequent caves and buildings in colonies.

Cave bats are generally brown in color. An adult Little Brown Bat is dull brown on the back and yellowish brown underneath with a wingspan of about 10 inches. The Big Brown Bat has a wingspan of approximately 13 inches and is similar in color. Both are light in weight, usually less than three-fifths of an ounce.

Bats are of the order *Chiroptera*, the only mammals capable of true flight. Although references are made to the mouse-like qualities of bats, they are more closely related to an ancient shrew or mole-like animal. Some 50 million years ago this animal developed extra skin along the sides of its body, similar to that of flying squirrels. Gradually the skin became a thin, generally hairless membrane, stretching from the body and tail to the greatly-elongated finger bones of the forefeet.

The fingers, acting as wing supports, allow bats to catch flying insects and flee from ground-dwelling predators. Two hooked claws, one located on the leading edge of each wing, are used by the bat to maneuver itself into a roosting position and to crawl through openings in tight quarters. All New Hampshire bats have enlarged ears and sharp teeth. Both aid them in locating and seizing prey. Studies have shown that bats locate objects by using reflected sound waves. As the animal flies, it utters a series of rapid, high-pitched squeaks which are reflected by nearby objects, not unlike a sonar system. Quick reflexes and this system of echolocation allow bats to pursue and capture insects in darkness while avoiding collisions with objects. Although bats fly primarily with the use of sensitive ears, their eyes are still functional.

Bats hang head-down while roosting, firmly secured by hooking their toes into cracks or around small projections. From this position they drop from the roost by releasing their grasp while momentum from the fall helps them become airborne.

Habits

Bats are often seen flying during the early morning, late afternoon or evening hours, feeding on insects which they capture in an unusual way. By shaping one wing membrane into a momentary pouch, bats scoop up their prey, quickly seizing the insect before it can escape. This entire event occurs in less than a second, appearing as an erratic, faltering flight when several insects are captured in succession. Insects are eaten which are as large as moths, beetles and ichneumon wasps and as small as gnats.

When bats are not feeding, they seek shelter in dark, protected refuges where they are safe from predation or disturbance. Places such as rock crevices, hollow trees, caves and unoccupied buildings are commonly used. Here the colony sleeps to conserve energy until times of increased insect activity.

With the advent of fall and the declining availability of food, tree bats migrate south of New England or southeast to the Bahamas. Cave bats begin their hibernation by short colony migrations to local caves, some as far distant as

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Vermont. During the colder months when insects are not available, bats must live off fat stored in their bodies. To insure the slow use of this fat, bats lower their body temperatures to the air temperature of caves, usually in the low forties. At this temperature their heartbeat and breathing slow to the point where physiological activities almost stop. When temperature and humidity conditions change during hibernation, the colony awakens and moves to another roosting site. In the spring, when the first frost-free days occur, hibernation will end with the colony's movement to its former summer roost.

Bats mate in the late summer, fall or during arousal periods in hibernation, but embryonic development does not begin until late winter or early spring. The young are born between the months of May and July. Reproductive rates are low, normally one or two per litter. The young are born naked and helpless and are carried by the mother for several days until they become too heavy. Young bats remain in the roost until they become self-sufficient at about six weeks of age. The life-span of bats is long, counterbalancing their low reproductive rate. Normal life expectancy is from three to seven years. Banding studies have shown that the Little Brown Bat may live up to 24 years, but these are exceptional cases.

Health Problems

Disease in all animal populations acts to control their numbers to greater or lesser degrees. Rabies appears to act as a limiting factor of bat populations. However, two limiting factors with greater effect on the numbers of bats are the death of young bats from falling off the mother or from the roosting site and a low yearly reproductive rate.

The number of reported cases of rabies is few. There are usually no more than three or four cases a year reported to the New Hampshire Fish and Game Department. Contrary to popular belief, bats will rarely attempt to bite unless an attempt is made to capture or handle them. However, rabid bats are unpredictable. *Bats which may be observed to fly into objects, or are on the ground, should be avoided.* Children should be warned against attempting to capture or touch bats because they will bite to defend themselves as do other animals.

In case of a bat bite, the area of the bite should be washed immediately with hot, soapy water and a physician promptly notified. If possible, capture the bat without damaging the head, place it in a jar or plastic bag and keep it under refrigeration. Thick leather gloves or even several thicknesses of a bath towel should be used to prevent another bite. Health authorities will want the bat for a rabies test to determine if treatment of the person bitten is necessary.

Identification

The presence of bats in buildings is easily determined. The odor of urine and accumulation of bat droppings from roosting bats indicate their presence. Dark droppings about the size of a pencil lead and from three-sixteenths to one-quarter of an inch long, will be found surrounding entrances and roosting sites. Because bat droppings are dry and very crumbly they are easily distinguished from mouse droppings. An abundance of insect fragments can be observed with a hand lens. Squeaking and fluttering may be heard as bats enter and leave the roosting site for their feeding flights. The easiest way to determine the presence of bats is to stand outside during the last half-hour of daylight and observe their exit points from the building. Openings that are continually used will be stained brown from the bats' oily fur. These openings provide a place to begin observations.

Little Brown and Big Brown Bats are found to roost in attics, storage areas, vacant buildings, openings in building walls and occasionally under eaves. Roosting in buildings is generally limited to the warmer months of late spring, summer and early fall. On occasion, the Big Brown Bat may hibernate in buildings during the winter months because of its higher tolerance to cold temperatures. If temperatures fall below freezing for several consecutive days, they will seek a warmer place for hibernation. However, it is most common for bats to migrate in winter from unheated roosts to warmer caves.

Control Measures

When it is necessary to remove bats from buildings, the most practical method is bat-proofing. All entrances and exits used by the bats should be closed and sealed. Entrances into buildings may include loose vents, broken windows, cracks in old siding, flashing around chimneys and openings under eaves. Smaller bat species have been known to crawl through openings three-eighths of an inch in width. For this reason, it is important to check for openings that may seem insignificant. Some sources report that bats can find openings in an attic by sensing air currents.

All bats should be out of the building before bat-proofing is completed. The roost normally becomes unoccupied 15 to 20 minutes after the first bat leaves the building. Bat colonies migrate from unheated buildings during the late fall (October-November) and reappear during the early spring (March-April). During this period, bat-proofing may be completed without the difficulties of colony removal. Bat-proofing should be restricted in May, June and July because young bats, not yet capable of flight, may occupy the roost.

Bright lights used to illuminate the roost may act as a repellent. This technique can be employed to remove bats while bat-proofing is completed. The smell of moth blocks will also act as a repellent. In cases where these repellents are used, bats will evacuate buildings even during daylight hours. Due to their rapid dissipation on contact with air,

repellents should not take the place of bat-proofing. Proofing is the only measure that will effectively prevent the establishment of new colonies.

The use of poisonous baits is impractical because bats feed primarily on flying insects. The use of poisons, gases and chemical controls by homeowners is illegal. Professional fumigation is not suggested due to problems of cost and odor from decomposing bats killed between walls. New colonies will become established if bat-proofing measures are not taken.

To close off entrances, re-nail boards and flashing. Larger entrances may be covered with sheet metal or boards. If ventilation is necessary, cover openings with one-quarter-inch mesh hardware cloth. Close cracks by packing them with steel wool or other packing material. Cover with caulking compound and paint. Also check points at which electrical wires enter.

Although most bats are unprotected by law, they should not be needlessly disturbed or destroyed. The Indiana Bat is protected under the 1973 Endangered Species Act.

The following bat control steps are suggested:

1. Observe and identify all entrances and exits.
2. Close all openings greater than one-quarter of an inch, leaving one entrance or exit open if several are used. Allow two or three days for bats to adjust to this opening. An open window or vent may be preferred.
3. Close the remaining openings after the colony leaves on its evening or early morning feeding flight.
4. Observe the building (eaves, chimneys and vents) for several evenings. If entrances were overlooked and bats are still present, the process should be repeated.
5. When the roost is cleaned to remove odors, a respirator should be used. Odors of bat urine and droppings will attract new colonies. Napthalene flakes will mask odors where there are large accumulations of droppings.

Environmental Importance

Bats occupy a special place where competition with other animals for food and shelter is minimal. They are considered beneficial because of the large quantities of insects consumed at each feeding. Some persons even allow bats to roost in unused buildings because of their insect diet. Others simply enjoy their presence on camping or fishing trips as part of the evening's scene.

We would like to acknowledge the assistance of Rene Bollengier and John Davis of the New Hampshire Fish and Game Department in the preparation of this pamphlet.

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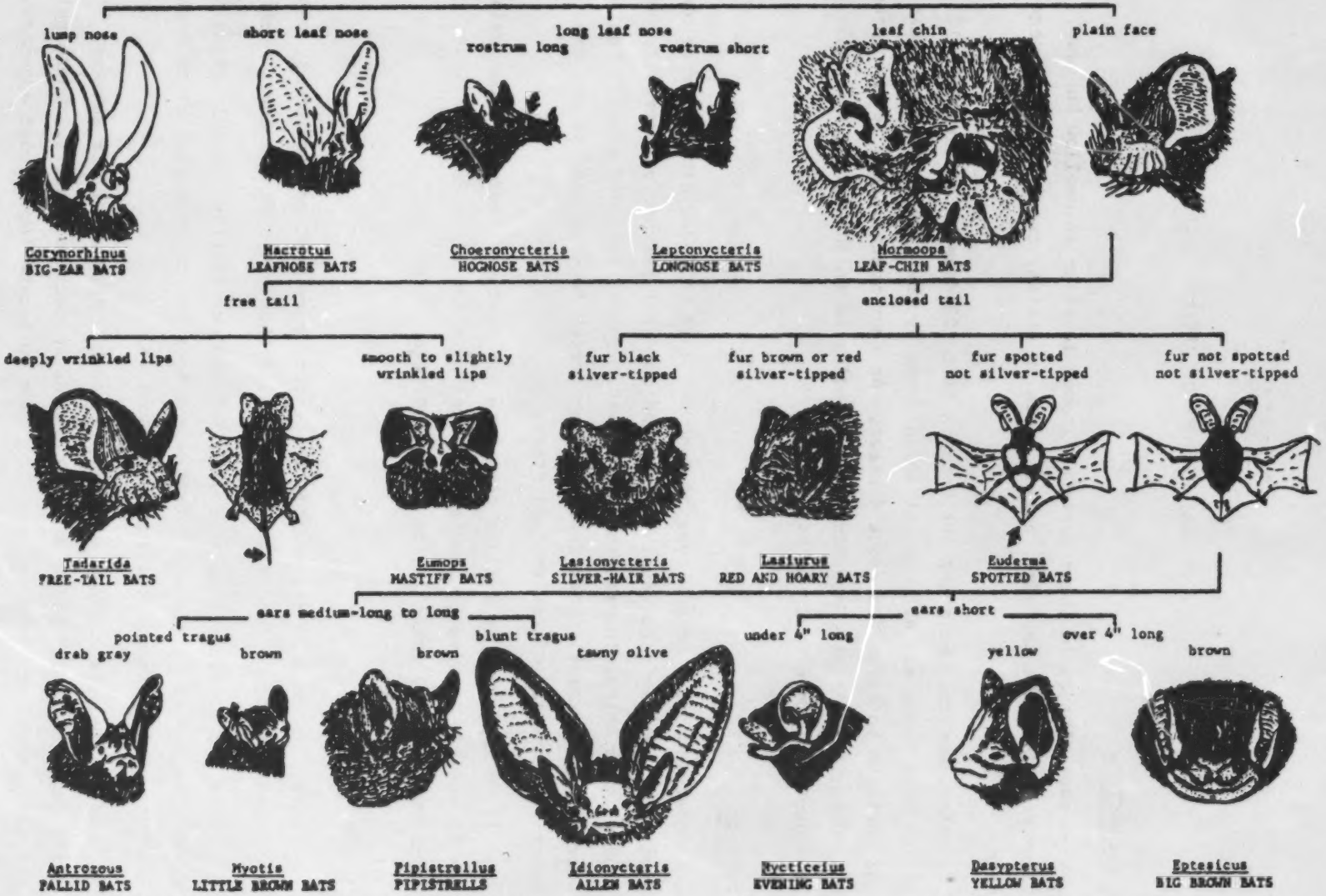
New Hampshire Department of Fish and Game, 34 Bridge Street, Concord, N.H. 03301. Tel. (603) 271-3421.

U.S. Fish and Wildlife Service, 55 Pleasant Street, Concord, N.H. 03301. Tel. (603) 225-9621.

BATS: PICTORIAL KEY TO UNITED STATES GENERA

Harold George Scott and Chester J. Stajanovich



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, Communicable Disease Center, Training Branch, Atlanta, Georgia – 1960 – Revised 1962

RODENTS

NATURAL HISTORY OF RATTUS

REPRODUCTION

Norway rats build their nests at ground level or in shallow burrows. Its close relative, the Roof Rat, builds nests in attics, trees and dense vegetation.

After mating, the young are born in 21 to 23 days in litters of 6-12 young. The young are able to eat solid foods by the time they are 3 weeks old, but continue to nurse for about 4 weeks. At four months, they reach reproductive maturity. In New Hampshire peak breeding is in the spring and fall. Reproductive rate of rats is high.

FEEDING

Most rats feed on any type of food but seem to favor certain types when available. Norway rats favor garbage and the Roof rat prefers cereals, nuts, fruits, vegetables, invertebrates and fish. Search for food usually begins shortly after sunset. When feeding, they prefer to drag food to enclosed areas where they are out of the exposed areas.

It is important to realize that rats are cautious feeders. When using a toxic bait, it is wise to pre-bait an area with non-toxic food at first. Toxicants may be added later in the control program.

SENSES

Rats have very poor eyesight, therefore, they must rely on smell, taste, touch and hearing to locate food and protect themselves from natural enemies.

Rats are considered to be colorblind and can distinguish only light from dark. The use of odorless and taste-free dyes for color coding baits does not interefere with the effectiveness of these baits.

A very important sensory factor is touch. Rats use their whiskers (vibrissae) and guard hairs on their bodies as tactile sensors. These help the rats travel in the dark, enabling them to locate food almost anywhere.

PHYSICAL CAPABILITIES (taken from Pest Control Magazine)

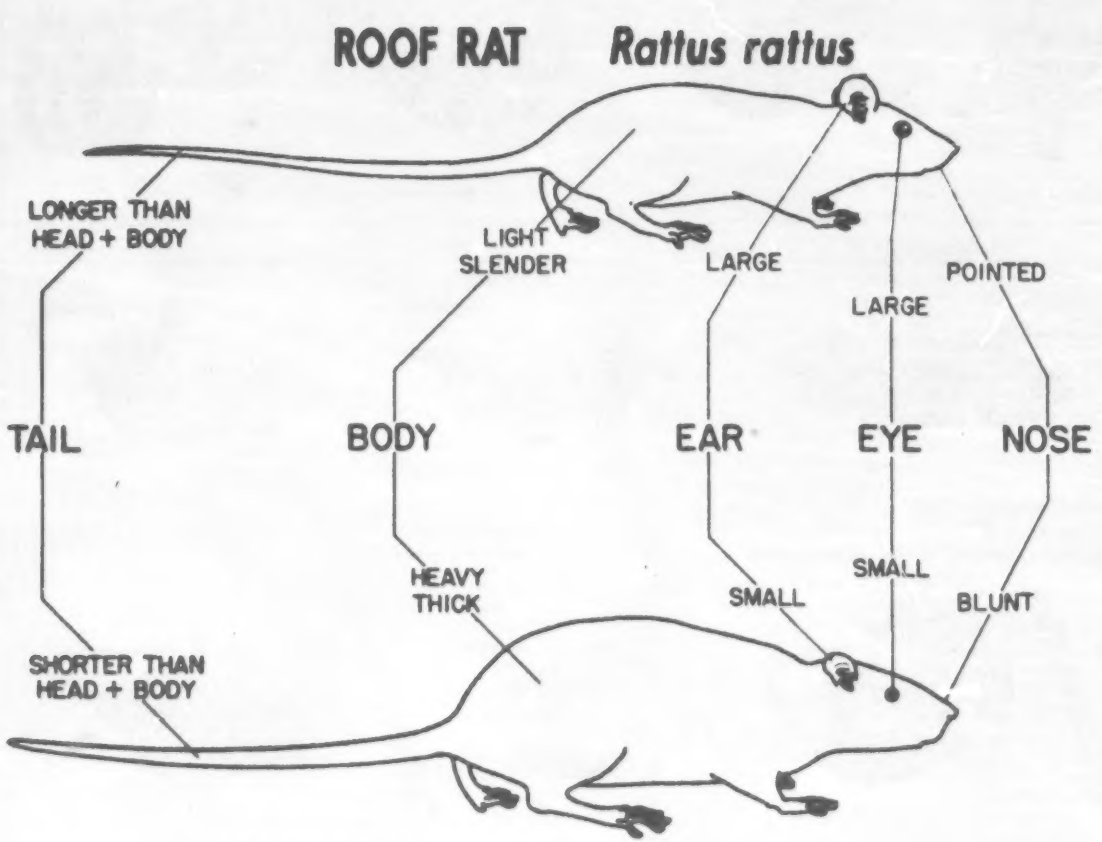
Rats can:

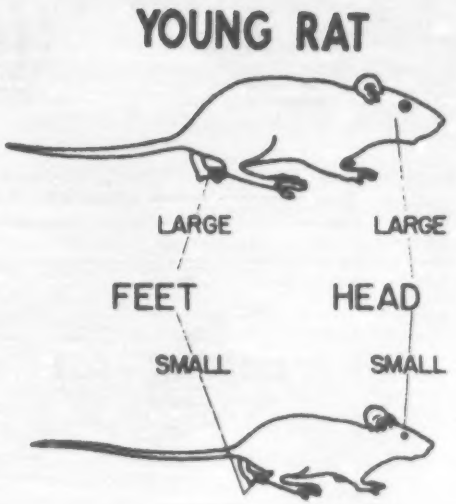
1. Gain entrance through any opening that is larger than ½ inch (1¼ cm) square;
2. Climb both horizontal and vertical wires;
3. Climb the inside of vertical pipes that are 1½ to 4 inches (4 to 10 cm) in diameter;
4. Climb the outside of vertical pipes of any size if the pipe is within 3 inches (7½ cm) of a wall or other continuous support for the rodent;
5. Climb the outside of vertical pipes and conduits up to 3 inches (7½ cm) in diameter;
6. Crawl horizontally on any type of pipe or conduit;
7. Jump vertically as much as 36 inches (1 meter) from a flat surface;
8. Jump horizontally 48 inches (1.2 meters) on a flat surface;
9. Jump horizontally at least 8 feet (2.4 meters) from an elevation of 15 feet (4½ meters);
10. Drop 50 feet (15 meters) without being killed or seriously injured;
11. Burrow vertically in earth to a depth of 4 feet (1¼ meters);
12. Climb brick or other rough exterior walls which offer footholds, to gain access to upper stories of structures;
13. Climb vines, shrubs, and trees, or travel along telephone or power lines to gain access to upper stories of buildings;
14. Reach as much as 13 inches (33 cm) along smooth vertical walls;
15. Swim as far as ½ mile (0.8 kilometer) in open water, dive through water plumbing traps, and travel in sewer lines even against substantial water currents;
16. Gnaw through a wide variety of materials including lead sheeting, sun-dried abode brick, cinder block, and aluminum sheeting.

ADULT MURINE RODENT CHARACTERISTICS

CHARACTER	NORWAY RAT	ROOF RAT	HOUSE MOUSE
BODY	Large, husky	Medium slender	Small, slender
BODY WEIGHT	200-480 g (7-17 oz.)	110-300 g (4-10 oz.)	15-23 g (.5-1 oz.)
TOTAL WEIGHT	325-460 mm (12-18")	350-450 mm (14-18")	150-190 mm (6-7")
TAIL LENGTH	125-215 mm (5-8")	150-255 mm (6-10")	75-100 mm (3-4")
TAIL	Shorter than body, paler below, carried stiffly behind the animal, coarse scales	Longer than body at least reaching the snout, unicolor, moves about with whip-like motion	Equal to or a little longer than body-head length, paler below
HEAD	Muzzle blunt	Muzzle sharply pointed	Muzzle pointed
EARS	Close set, short, thick with short, fine hairs	Upright, thin, large hairless	Large with some hairs
EAR LENGTH	Rarely over 20 mm (3/4")	Over 20 mm (3/4")	Up to 15 mm (1/2")
HIND FOOT LENGTH	Over 40 mm (1.5")	Over 20 mm (3/4")	Under 20 mm (3/4")
NUMBER TEATS ON FEMALES	12	10-12	10
COLOR OF BELLY FUR	White with gray underfur	Uniform - all white, all buff or all gray	White to dark gray
OVERALL APPEARANCE	Coarse, brownish gray	Gray, black or brown	Fine brownish gray to gray
DROPPINGS	Up to 20 mm (3/4")	Up to 10 mm (1/3")	Up to 6 mm (1/4")

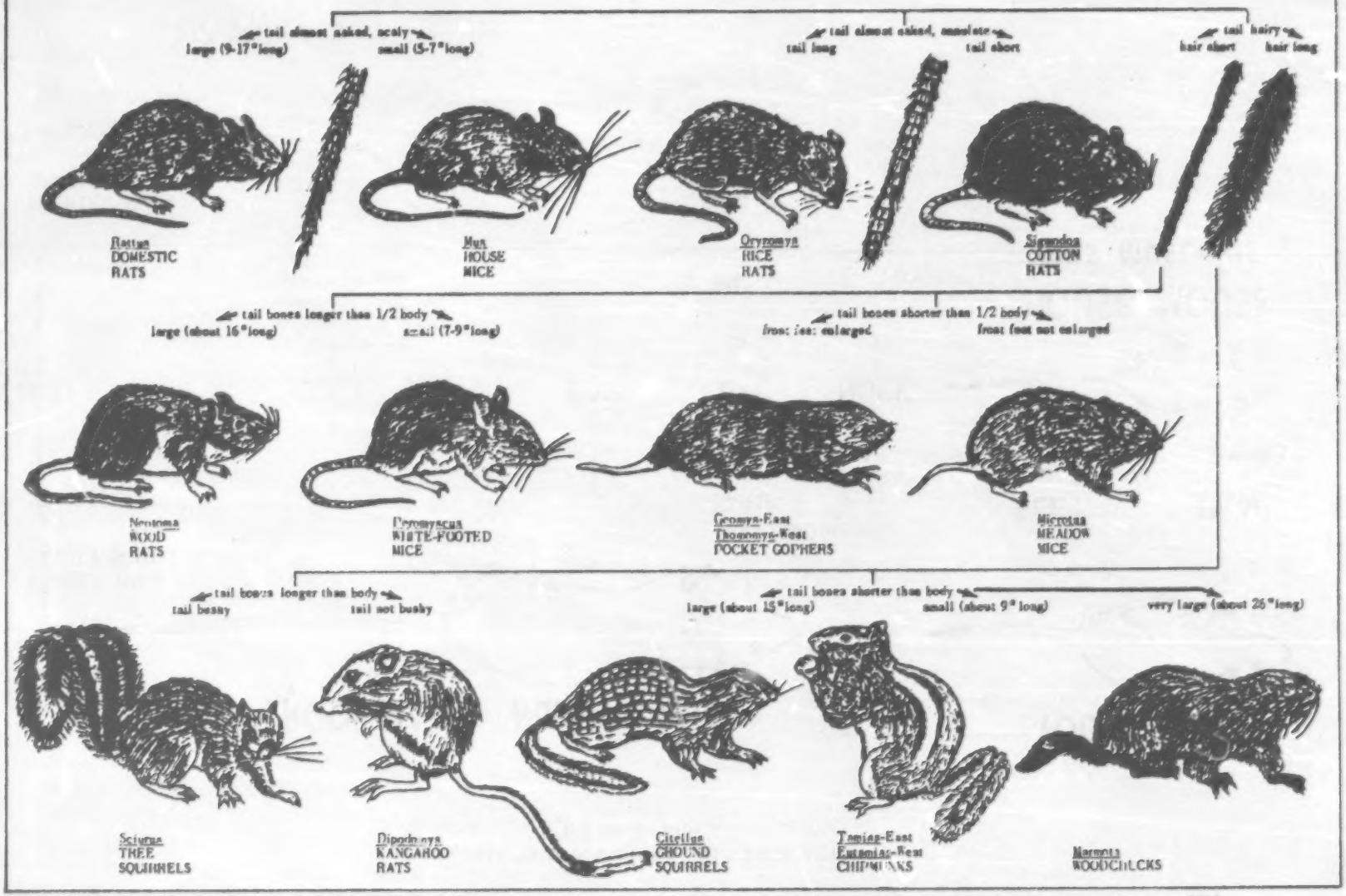
DOMESTIC RODENT FIELD IDENTIFICATION
Robert Z. Brown





RODENTS: PICTORIAL KEY TO SOME COMMON UNITED STATES GENERA

Harold George Scott and Margery E. Borom



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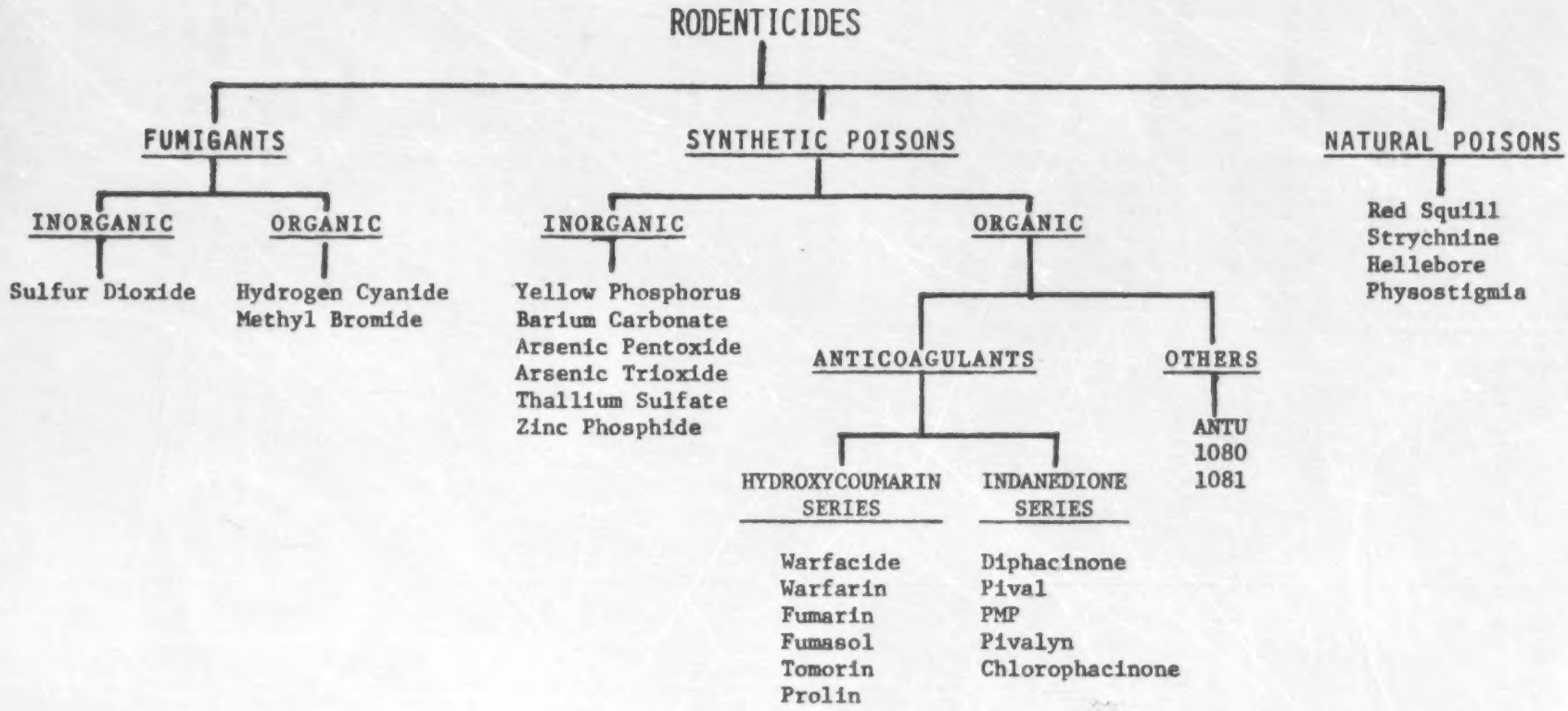
RODENTICIDES
FUMIGANTS
SYNTHETIC POISONS
NATURAL POISONS
INORGANIC
ORGANIC
INORGANIC
ORGANIC
Red Squill
Strychnine
Hellebore
Physostigmia
Sulfur Dioxide
Hydrogen Cyanide
Methyl Bromide
Yellow Phosphorus
Barium Carbonate
Arsenic Pentoxide
Arsenic Trioxide
Thallium Sulfate
Zinc Phosphide
ANTICOAGULANTS
OTHERS
ANTU
1080
1081
HYDROXYCOUMARIN SERIES
INDANEDIONE SERIES
Warfacide
Warfarin
Fumarin
Fumasol
Tomorin
Prolin
Diphacinone
Pival
PMP
Pivalyn
Chlorophacinone

In order to counteract poisoning which may occur, P.C.O.'s must be aware of certain antidotes available. In the case of an emergency, the Poison Control Center for New Hampshire is at Mary Hitchcock Hospital, Hanover, N.H. (603) 643-4000.

POISON	%BAIT	HAZARD TO HUMANS	ANTIDOTE
Anticoagulants	0.025	Slight	Vitamin K and whole blood. Call a physician immediately.
Red Squill	10	Slight	Acts as its own emetic*
Zinc phosphide	1	Moderate	Copper sulfate before emetic: catharic and water; avoid fats and oils.
Arsenic trioxide	3	Moderate	Milk of magnesia, milk + water
ANTU	3	Moderate	NONE
1080	½ oz. per gallon	Extreme	None reliable (Monoacetin or ethyl alcohol and acetic acid recommended)
Thallium sulfate	0.7	Extreme	None reliable; sodium iodide and sodium thiosulfate recommended
Strychnine (alkaloid) (sulfate)	 0.6 0.8	 Moderate Moderate	 No emetic after 10 minutes. Charcoal in water and sedative; Keep in dark room.
Hydrogen cyanide		Extreme	Give oxygen and/or artificial respiration and amyl nitrate inhalation. Ferrous sulfate (158g) plus citric acid crystals (3g) dissolved in 1 litre of cold distilled water; Anhydrous sodium carbonate(60g) dissolved in 1 litre of distilled water. Seek medical help immediately; usually injection of cobalt edetate.

*Emetic: This is a substance used to induce vomiting. Readily available emetics include table salt, powdered mustard in water or milk. It is recommended that tartar emetic be added to baits where domestic animals are likely to feed upon the poisoned baits. This will help reduce the incidence of domestic animal poisoning.

Cooperative Extension Service
University of New Hampshire

Wildlife
Information
Series 2

WOODCHUCKS

Prepared by H. Stevan Logsdon, Extension Wildlife Specialist and Craig R. Fox

Cooperative Extension Service, University of New Hampshire, in cooperation with the Institute of Natural and Environmental Resources, Pettee Hall, Durham, N.H. 03824, Tel. (603) 862-1000

Woodchucks, or groundhogs, are the most widely-distributed mammal in New Hampshire. Two subspecies of woodchucks, the Canada Woodchuck *(Marmota monax canadensis)* and the New England Woodchuck *(Marmota monax preblorum)* are found in this State.

Woodchucks are classified as rodents. Their chisel-shaped teeth are used for eating plants and gnawing, while their short legs and stout body are adapted to burrowing. Strong leg muscles and long, curved claws on their forefeet make them powerful diggers. From head to tail, woodchucks are approximately 20 to 27 inches long and weigh from five to 12 pounds.

Although woodchucks are normally yellowish-brown or dark brown in color, albanistic (white) to melanistic (black) variations occur. The backs of woodchucks have a frosted appearance and their feet are dark brown or black.

The eyes, ears and nose of the woodchuck are all located at the top of the head. This allows them to see over the rim of their burrows without being spotted by predators. The ears and nose of the woodchuck are sensitive allowing them an early warning of danger. Although they are slow runners, woodchucks are alert and quick to scurry to their dens when approached.

Habits

During the summer months, woodchucks are often seen feeding along the edges of fields, periodically rising up on their hind legs to look for danger. The early morning and evening hours are preferred for feeding as woodchucks depend on dew for much of their water intake. Large quantities of succulent plants, such as clover, grasses and plantain are eaten. On occasion, snails, grasshoppers and buds of young trees may also be consumed. In one day, a woodchuck may eat the equivalent of one-third of its body weight.

Woodchucks often forage into the late morning and resume in mid-afternoon. During the warmest hours of the day, they may be found basking in the sun. Woodchucks sleep on the tops of fence posts, on stone walls, large rocks and fallen logs, all of which are close to a burrow entrance. Even when feeding, woodchucks usually travel no farther than 50 yards from their dens. However, male woodchucks have been known to travel long distances to find a mate. On occasion, woodchucks will travel several hundred yards to eat fallen orchard fruits.

Burrows are typically located on the edges of woodlands, in fields or along fence rows. Woodchucks prefer areas which provide satisfactory cover and are near a food source. Often they will take up residence in stonewalls or woodpiles, using several auxiliary dens for shelter.

Woodchuck burrows are from 25 to 30 feet long and from two to five feet deep. Normally two or three entrances are used, although there may be as many as five entrances. The main entrance is identified by the mound of excavated dirt and stones which surrounds it. Hidden entrances are used for quick escapes from predators. A single chamber is formed at the end of the main entrance burrow which is used for sleeping and the raising of young. Another room is used for urination and defecation. In this way the den is kept relatively clean and free from disease.

In the late summer woodchucks are abundant in fields. Their increased feeding insures a heavy layer of fat from which woodchucks draw nourishment during winter months. As cold weather approaches, woodchucks move to woodland dens. The nesting chamber is lined with dried grasses and leaves to add increased insulation.

Hibernation begins with killing frosts in the fall (late September to early October) and ends in the early spring (March or April) before the snow has fully melted. Woodchucks are one of the few mammals which go into true hibernation. Most animals become stupored for short

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periods of time (weeks or months), awakening during warm periods to forage for food. However, woodchucks hibernate for 4½ to 5½ months without awakening. During this time their body temperature falls to that of the den and respiration rates drop to approximately one inhalation every five minutes. A reduced rate of metabolism allows woodchucks to live from their fat until spring when food supplies are again available.

Woodchucks awaken early to mate during February or March. Male woodchucks break out of their snow-covered burrows to travel to other nearby dens where females are hibernating. Mating takes place in the den, after which woodchucks resume their hibernation. A mated pair will live in the same den until the young are born, in April or May. There are two to six (usually four) young to a litter and one litter per year. After the young are weaned and partially grown, they disperse to abandoned dens or dig their own.

The average lifespan of woodchucks is four to five years. Hawks and foxes commonly prey on young woodchucks, helping to limit their numbers.

Identification

Woodchucks become nuisances when their feeding and burrowing habits conflict with other land uses. They may feed on home gardens and hay or field crops. Occasionally, woodchucks damage young trees in orchards and nurseries. During the spring they may eat the buds of trees when other food is scarce. Woodchucks have been observed climbing trees for fruit. However, they normally cause little damage to fruit crops as woodchucks prefer to feed on fruit that has fallen to the ground. The burrows and mounds of woodchucks in fields may also cause difficulty in the operation of certain farm machinery in locations where their numbers are unusually high. Alfalfa, soybeans and other domestic legumes are especially attractive to woodchucks.

Woodchuck damage in home gardens may be identified by observing which vegetables are eaten and how they are consumed. Peas, beans and the tops of carrots are most commonly eaten, although woodchucks will forage on most garden vegetables. When pea and bean plants are sprouting, the entire plant is often taken. Corn is not normally damaged by woodchucks. But raccoons or squirrels commonly feed on this crop.

Tracks are a reliable means of identifying the animal causing damage. The forefeet of woodchucks have four toes. The hind feet are two to three inches long. Claw marks will be present in all of the tracks. When an adult woodchuck walks, there are normally four inches between tracks and the hind foot partially covers the forefoot track. In cases where tracks are not present, flour may be sprinkled at damage sites in the garden. Tracks in the flour should be visible the following day.

Control Measures

Woodchucks are usually difficult to control. No method, with the exception of fencing, is considered permanent. Several methods of control by the homeowner may be used without destroying the woodchuck.

The most permanent method of control is fencing. The practicality of fencing depends on the size of the area to be fenced. Fencing also acts to protect the garden from other wildlife and domestic animals or pets. Because woodchucks are excellent burrowers, it is necessary to sink the fencing one to two feet into the ground. The entrance gate into the garden should be sturdy and flush with the fence. Some gardeners prefer to build two separate sets of steps over the top of the fence. When the garden is left, the steps on the outside of the fence are moved. Because woodchucks are good climbers, they may even enter a fenced garden. One foot of fencing, bent outwards from the top, should deter climbing woodchucks. Electric fencing has been used with varying degrees of success. If damage continues, other control methods may be used to remove the woodchuck.

Live-trapping may best serve to remove one or two problem animals from an area. Where food is abundant, woodchucks may not enter live-traps for bait. Traps may be placed at burrow entrances or at the site of damage and should be baited with apples or other fresh fruit. Metal live traps are most efficient, because woodchucks may chew their way out of wooden box traps. Traps should be checked in the morning and evening so that trapped animals are dealt with humanely. After woodchucks are trapped, they should be transported no less than five miles and released in a suitable habitat. Woodchucks should not be live-trapped in the fall immediately before hibernation or during the spring while young are in the dens. Animals trapped and released before hibernation may not be able to locate dens. Trapping female woodchucks in the spring may cause the death of their young.

A one percent solution of Rotenone spray applied to vegetables will normally act as an irritant, temporarily

deterring woodchuck damage. Rotenone is not registered for use in controlling woodchucks and should be applied only as an *insecticide*. The presence of Rotenone will *not* insure permanent control. Pesticides and rodenticides should always be used sparingly and carefully. The instructions should be followed to insure safety.

Where fencing is not practical and woodchucks are too abundant to live-trap, gas cartridges can be employed. Dens should be gassed in the early spring when active burrows may be most readily located. Burrows should be observed to insure that the use is by woodchucks to minimize damage to other wildlife. Tracks at den entrances should be identified. Gas cartridges should not be used near dry brush or buildings because of fire hazard. It is illegal to use gas cartridges to kill furbearers or other game species. Follow directions on the label to insure safe use of cartridges.

In some cases, the use of a telescopic rifle may be necessary to eliminate problem woodchucks. A hunting license must be obtained and safety precautions taken. In recent years there has been no closed season or limit on the number of woodchucks that may be shot. They should be hunted during late July, August and September after the young have left the dens. If woodchucks are hunted in the spring or early summer, their dens should be gassed to minimize the suffering of the young.

Where safety requirements do not allow gassing or hunting, steel-jaw traps may be used. Because of the woodchuck's strength, a number two steel trap or number 110 conibear should be used. Set traps at the site of damage and bait with fruit. Traps should be checked in the morning and evening and covered at night. Traps should not be used in populated areas where the possibility of capturing neighbors cats or dogs exists. *Caution should be taken to prevent unnecessary trapping of other wildlife.* For resident landowners and in cases where woodchucks are causing damage, a trapping license is not required.

Environmental Importance

Woodchucks are considered by some persons to be one of the most important residents of the rural wildlife community. Without the activity of woodchucks the abundance of game along the field edge would not be as plentiful. Their abandoned dens provide escape cover and shelter for rabbits, raccoons and opossum. Chipmunks often enter burrows during the winter to hibernate while weasels use them for temporary refuge. Skunks and foxes, which feed on crop-damaging insects and field mice, frequently take up residence in woodchuck dens. Woodchucks indirectly help the farmer by providing homes for beneficial wildlife and shelter for game animals.

We would like to acknowledge the assistance of Rene Bollengier and John Davis of the New Hampshire Fish and Game Department in the preparation of this pamphlet.

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Wildlife
Information
Series 3

MOLES

Prepared by H. Stevan Logsdon, Extension Wildlife Specialist and Craig R. Fox

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Two species of moles are found in New Hampshire. Star-nosed Moles *(Condylura cristata)* frequent damp soils near swamps, streams and lake edges. Hairy-tailed Moles *(Parascalops breweri)* prefer well-drained upland soils. Both are common throughout the State.

Moles are small, mouse-sized mammals adapted to living underground. They are characterized by enlarged forefeet with long claws, stout necks and powerful shoulders which make them capable burrowers. Unlike those of mice and shrews, the noses and forefeet of moles are pink and hairless.

Hairy-tailed Moles have slate-colored fur while Star-nosed Moles are normally dark brown or black. Both moles have hair-covered tails. However, Star-nosed Moles have longer tails and the numerous fleshy nose projections for which this mole was named. Moles generally range from five to seven inches in length.

Special sensory hairs on the noses and forefeet of moles enable them to find food in a subterranean environment where other senses are not as useful. The eyes of moles are almost entirely covered by skin and their ears are hidden. Although moles do not appear to sense light with their eyes, their ears may be used to hunt and to evade predators. Some sources attribute the successful establishment of moles underground to the increased development of senses which can detect changes in air pressure, temperature and movement.

Habits

Moles burrow by forcing their enlarged forefeet into the soil and pushing backward and to the side. The mole's velvety fur may be brushed in any direction without resistance. This enables the animal to move backwards or forwards with a decreased expenditure of energy and increases its food-securing ability. Within a 24-hour period a mole may consume the equivalent of one-half its body weight. Moles feed during the day and night, generally stopping for three resting periods. Earthworms and soil invertebrates, such as the larval or grub forms of insects, constitute the largest portion of their diet. Moles also feed on spiders, snails, small vertebrates and eat small amounts of bulbous or fleshy-rooted vegetation. Moles have been observed to feed on the carcasses of buried animals. The Star-nosed Mole, which frequently enters water, may consume aquatic insects and small fish.

Although moles prefer loose, sandy-loam soils, they have been observed to occupy a variety of habitats and soil types. Requirements for moles include adequate soil moisture and depth. The amounts of vegetation and organic matter present affects the abundance of soil animals upon which moles feed. Moles normally avoid dry, clay or highly-acidic soils because such soils contain a scarce supply of food and are difficult to burrow through. Conversely, moles will move into an area where food is abundant and soil conditions are optimal.

Two types of burrows are made by moles. Surface tunnels are created as moles move through the soil in search of food. Deeper passages are dug joining the nesting cavity to an elaborate system of burrows. The passages are marked by piles of excavated earth on the ground surface. The maze of burrows surrounding the nesting chamber increases the likelihood of escape from predators and may serve to aerate the moles' nests. Large numbers of surface tunnels are dug to insure a sufficient supply of food as moles depend on earthworms and insects which enter or fall into their runways for most of their diet. Moles form hardened chambers where they store large numbers of earthworms. Occasionally moles leave their burrows to feed above ground and to collect grasses and leaves for the nesting cavity.

Moles are strongly territorial and will defend their burrows against intrusion by others. Most burrow systems are separate, with only one male or female using the complex. Where contacts are made, fighting often occurs

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which may end in death. This serves to limit mole populations, which in turn, insures enough food for the occupants of individual territories. Contacts between moles occur infrequently except during the late winter (February to April) when they breed. During the breeding season male moles dig straight tunnels to intersect the territories of females. After mating, moles re-inhabit separate burrow systems. Gestation lasts for four to six weeks after which two to five (usually four) young are born. The young grow rapidly and leave the nest after four weeks to forage for themselves. Young moles which do not find abandoned burrows often live at the surface for brief periods of time before deeper burrows are made. Raised burrows are often observed after the spring snow melt.

The average lifespan of most moles is from two to three years. Because Hairy-tailed and Star-nosed Moles venture to the ground surface where they are exposed to increased predation, their lifespans are usually much shorter. Animals which commonly prey on moles include hawks, owls, herons, foxes, skunks, weasels and snakes.

Identification

Moles become nuisances where their surface tunneling or burrow excavations extend into lawns, golf courses and gardens. Because of the burrowing ability of moles, numerous runways and piles of dirt may appear in a relatively short period of time. Where mole numbers are few and tunneling is minimal, they will normally not cause serious damage.

Grass, flower beds, vegetable gardens and shrubs may be indirectly damaged by the physical disturbance of plant roots which are in proximity to mole tunnels. Moles occasionally feed on the roots of plants. Gnawed or girdled trees and shrubs or chewed vegetables are usually the work of meadow mice which often use the surface tunnels of moles for runways. Although moles occasionally damage plants, their activities are beneficial since they aerate and mix the soil. Their burrowing increases the availability of water to plant roots and the numbers of unwanted insects may be reduced.

Mole activity is normally obvious. Continuous ridges of raised earth and small mounds of dirt will be observed where moles have burrowed. Star-nosed Moles are rarely nuisances because they prefer wetter habitats.

Control Methods

Moles are usually difficult to control. Limited populations of moles may be satisfactorily reduced by trapping with the "harpoon" or "prong" type trap. Traps are available through farm and garden supply or hardware stores. Directions are supplied by the manufacturers.

Successful trapping involves the identification of actively-used tunnels and an understanding of mole activities. Runways which are not abandoned and are being used as moles feed and travel may be identified by depressing short sections of the raised ridges. Depressed sections should be marked with flagging and checked for repairs. Tunnels which have not been repaired are abandoned and should not be used for trapping. Set traps only at active locations and move them to other active sites within two to three days if no moles are caught.

Moles entering a garden may be deterred by sinking one-quarter-inch wire mesh fencing 1½ to two feet into the ground, allowing at least one foot of mesh above ground. Where mounds of earth are present in the garden, trapping may be necessary to remove moles before the garden is enclosed.

In cases where mole populations are unusually dense, their food supply may be reduced. A reduction of soil insects and earthworms with the use of insecticides may cause moles to starve or to seek other food sources nearby. *Careful consideration should be given to the detrimental effects of insecticide use.* Insecticides are highly toxic and may be harmful to people, pets and other forms of wildlife such as birds which eat toxic earthworms. Elimination of soil organisms which aerate and mix lawn or garden soils may do more damage to vegetation than digging by moles. Because soil organisms limit fungus growth in soils, a reduction of these organisms may result in the spread of lawn or crop-damaging fungi. Fungus growth can result in large patches of brown and dying grass. Before insecticides are used current information on chemical controls should be obtained from the county Cooperative Extension Service office. The addition of fertilizers or humus to lawns will increase the numbers of earthworms and insects present, creating a habitat which may attract moles.

Gassing is normally ineffective because of the moles' extensive burrow system and its numerous openings. Repellents have not been successful and the use of poisonous baits is currently illegal.

Ecological Significance

Although moles become nuisances, their presence in woodlands or overgrown fields is seldom noticed. They aerate and loosen the soil which improves conditions for vegetative growth. Because moles require large amounts of food, they act to limit some species of insects while providing an important food source for a number of predators. A reduction in numbers may be more desirable than complete elimination.

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New Hampshire Department of Fish and Game, 34 Bridge Street, Concord, New Hampshire 03301. Tel. (603) 271-3421.

U.S. Fish and Wildlife Service, 55 Pleasant Street, Concord, New Hampshire 03301. Tel. (603) 225-9621.

BIRDS: PICTORIAL KEY TO SOME COMMON PEST SPECIES OF PUBLIC HEALTH IMPORTANCE

Margaret A. Parsons and Chester J. Stojanovich

bill short

bill long

male and female, body plump, tail fan-like

body trim, tail not fan-like

COMMON PIGEON

male, body black, head brown
female, overall dull grey color

male, black throat, grey crown
female, whitish throat, dull eye stripe

male

female

female

male

COMMON COWBIRD

HOUSE SPARROW

male, wing with red 'epaulettes'
female, breast heavily striped, light eye stripe

wing without 'epaulettes'
breast not heavily striped

female

male

RED-WINGED BLACKBIRD

males, plain bronze or dull purple back, tail long
females, less iridescent, smaller size

winter, bill dark, body heavily speckled with light dots
spring, bill yellow, color purple and green

male and female, very large size, coal black color, tail flat

winter phase

summer phase

GRACKLES

STARLING

CROWS

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